Mr. Blundevil
HIS
EXERCISES,
CONTAYNING
Eight Treatiſes,

The Titles whereof are ſet down in the next printed page.

Which **Treatiſes are very neceſſary to be read** and learned of all young Gentlemen, that have not been exerciſed in ſuch Diſciplines, and yet are deſirous to have knowledge as well in *Coſmographie*, *Aſtronomie*, and *Geographie*, as alſo in the Art of *Navigation*, in which Art it is impoſſible to profit without the help of theſe or ſuch like Inſtructions.

To the furtherance of which Art of *Navigation*, the ſaid Mr. Blundevil ſpecially wrot the ſaid Treatiſes, and of meere good-will doth Dedicate the ſame to all young Gentlemen of this Realme.

The ſeventh Edition corrected and ſomewhat enlarged by Ro. Hartwell *Philomathematicus.*

LONDON,
Printed by *Richard Biſhop*, and are to be ſold by *William Hope* at the Vnicorn neere the royall Exchange. 1638.

THE TITLES OF THE *TREATISES* contained in this BOOKE.

FIrſt, a very eaſie Arithmetick, ſo painely written as any man of a meane capacity may eaſily learne the ſame, without the help of any teacher.

Item the firſt principles of Coſmography, and eſpecially a plaine Treatiſe of the Spheare, repreſenting the ſhape of the whole world, together with the chiefeſt and moſt neceſſary uſes of the ſaid Spheare.

Item a plaine and full deſcription of both the Globes, as well Terreſtriall as Celeſtiall, and all the chiefeſt and moſt neceſſary uſes of the ſame, in the end whereof are ſet down the chiefeſt uſes of the Ephemerides of *Iohannes Stadius*, and of certaine neceſſary Tables therein contained, for the better finding out of the true place of the Sunne and Moone, and of all the reſt of the Planets upon the Celeſtiall Globe.

Item a plaine and full deſcription of *Peter Plancius* his univerſall Map, lately ſet forth in the yeere of our Lord 1592, containing more places newly found, as well in the Eaſt and Weſt Indies, as alſo towards the North Pole, which no other Map made heretofore hath, whereunto

is alſo added how to finde out the true diſtance betwixt any two places on the Land or Sea, their longitudes and latitudes being firſt knowne, and thereby you may correct the Scales or Tronkes that be not truly ſet downe in any Map or Card.

Item, a briefe and plaine deſcription of M. *Blagrave* his Aſtrolabe, otherwiſe called the Mathematical Iewell, ſhewing the moſt neceſſary uſes thereof, and meeteſt for Sea-men to know.

Item, the firſt and chiefeſt Principles of Navigation more plainely, and more orderly taught than they have beene heretofore by ſome that have written therof, lately collected out of the beſt modern Writers, and Treaters of that Art.

Item, a briefe deſcription of univerſall Maps and Cards, and of their uſe: And alſo the true uſe of *Ptolomie* his Tables, together with the true order of making the ſaid Tables. And of all other Maps and Cards as well univerſall as particular, and that according to the doctrine of the beſt Geographers that be, or have beene in theſe later dayes.

Item, the true order of making of *Ptolomie* his Tables, and alſo the making of all other Tables, Maps or Cards, as well univerſall as particular, and that according to the doctrine of the beſt Geographers that be or have beene in theſe later dayes.

And moreover, I have thought good to adde unto mine Arithmeticke, as an appendix depending thereon, the uſe of the Tables of the three right lines belonging to a circle, which lines are called Sines, lines Tangent, and lines Secant, whereby many profitable and neceſſarie concluſions, as well of Aſtronomy, as of Geometrie are to be wrought

wrought onely by the helpe of Arithmetick, which Tables are set down by *Clavius* the Iesuite, a most excellent Mathematician, in his Booke of demonstrations made upon the Spheriques of *Theodosius*, more truly printed than those of *Monte Regio*, which Booke whiles I read at mine own house, together with a Loving Friend of mine, I tooke such delight therein, as I minde (God willing) if God give me life, to translate all those propositions, which *Clavius* himselfe hath set downe of his owne, touching the quantity of Angles, and of their sides, as well in right line Trangles, as in the Spherical Triangles, of which matter, as *Monte Regio* wrote diffusedly, and at large, so *Copernicus* wrote of the same briefly, but therewith somewhat obscurely, as *Clavius* saith. Moreover, in reading the Geometry of *Albertus Durerus*, that excellent Painter, and finding many of his conclusions very obscurely interpreted by his Latine Interpreter (for hee himselfe wrote in high Dutch) I requested a friend of mine, whom I knew to have spent sometime in the study of the Mathematiques, not only plainely to translate the foresaid *Durerus* into English, but also to adde thereunto many necessary propositions of his owne, which my request hee hath (I thanke him) very well performed, not only to my satisfaction, but also to the great commodity and profit of all those that desire to be perfect in Architecture, in the Art of Painting, in free Masons craft, in Ioyners craft, in Carvers craft, or any such like Art commodious and serviceable in any common Wealth, and I hope that he will put the same in print ere it bee long, his name I conceale at his owne earnest intreatie, although much against my will, but I hope that hee will make himselfe known in the publishing of his Arith-

metick, and the great Art of *Algebra*, the one being almoſt finiſhed, and the other to be undertaken at his beſt leaſure, as alſo in the Printing of *Durerus*, unto whom he hath added many neceſſary Geometricall concluſions, not heard of heretofore, together with divers other of his workes, as well in Geometry, as in other of the Mathematicall Sciences, if hee be not called away from theſe his ſtudies by other affaires. In the meane time I pray all young Gentlemen and Sea-men to take theſe my labours already ended in good part, whereby I ſeeke neither prayſe nor glory, but only to profit my Country.

To

To the Reader.

I Greatly rejoyce to ſee many of our Engliſh Gentlemen, both of the Court and Country in theſe dayes, ſo earneſtly given to travell as well by Sea as Land, into ſtrange and unknowne Countries, and ſpecially into the Eaſt and Weſt Indies, following therein the good example of divers worthy Knights and Gentlemen, that have ventured their lives to diſcover ſtrange Countries to the great honor of their Country and to their owne immortall fame. And becauſe that to travell by Sea requireth skil in the Art of Navigation, in which it is impoſſible for any man to be perfect, unleſſe he firſt have his Arithmetick, and alſo ſome knowledge in the principles of Coſmography, and ſpecially to have the uſe of the Spheare, of the two Globes, of the Aſtrolabe, and Croſſe-ſtaffe, and ſuch like inſtruments belonging to the Art of Navigation, I thought good therefore to write the Treatiſes before mentioned, to ſerve as an introduction for ſuch yong Gentlemen as have not been exerciſed in ſuch kind of ſtudies, which Treatiſes if they ſhall vouchſafe to read with attentive minde, and in ſuch order as they are before ſet down, I doubt not but that it will cauſe them hereafter to ſeeke for further knowledge therein. And in any wiſe I wiſh them to begin with my Arithmetick, the contents whereof are declared in the next Chapter following, In the meane time I do earneſtly requeſt all yong Gentlemen, to take theſe my ſimple Pamphlets no leſſe thankfully than they have done my Horſe-booke, and in ſo doing, I ſhall have juſt cauſe to thinke my labour well beſtowed.

What

What cauſe firſt moved the Author to write this Arithmetick, and with what order it is here taught, which order the contents of the Chapters thereof hereafter following do plainly ſhew.

I *Began this Arithmetick more than ſeven yeeres ſince for a vertuous Gentlewoman and my very deare friend* Mrs. Elizabeth Bacon, *the daughter of Sir* Nicholas Bacon *Knight, a man of moſt excellent wit, and of moſt deepe iudgement, and ſomtime Lord Keeper of the great Seale of* England, *and lately (as ſhe hath beene many yeers paſt) the moſt loving and faithfull wife of my worſhipfull friend M. Iuſtice* Windham, *not long ſince deceaſed, who for his integrity of life, and for his wiſedome and juſtice daily ſhewed in government, and alſo for his good hoſpitality, deſerved great commendation. And though at her requeſt I had made this Arithmeticke ſo plaine and eaſie as was poſſible (to my ſeeming) yet her cominuall ſickneſſe would not ſuffer her to exerciſe her ſelfe therein. And becauſe that divers having ſeene it and liking my plaine order of teaching therein, were deſirous to have Copies thereof, I thought good therefore to print the ſame, and to augment it with many neceſſary Rules, meet for thoſe that are deſirous to ſtudy any part of Coſmographie, Aſtronomie, or Geographie, and ſpecially the Art of Navigation, in which without Arithmeticke, as I have ſaid before, they ſhall hardly profit. But now to returne to my matter, the contents of this*

this Arithmeticke are theſe here following. First, having deſined what Arithmeticke is, and what numeration or numbring is, and of what parts it conſiſteth, and how to number any great ſumme written in many figures, I deale with the foure ſpeciall kinds of Arithmetick, that is, Addition, Subtraction, Multiplication, and Diviſion. Then I ſhew the order of working in whole numbers called in Latine Integra, by the rule of proportion, otherwiſe called the golden rule or the rule of three; Then I treat of broken numbers called fractions, ſetting down ſeven neceſſary rules, belonging thereunto, by the helpe whereof you ſhall be the better able to adde, ſubtract, to multiply, and divide the ſame. That done, I ſhew how to uſe the rule of three, as well in dealing with ſole Fractions, as with Fractions annexed to Integrums, which rule of three is threefold, that is, the cõmon rule, the rule reverſe, & the double rule, the order of all which three kinds, I do plainly teach by examples, ſhewing therein, how and when they are to be uſed. Next to thoſe I ſet down the rule of fellowſhip, a neceſſary rule for thoſe that have to trafficke in any trade of Merchandiſe, giving divers examples thereof. Next to that I treat of Arithmetical & Geometricall Progreſſion, and alſo of Proportion, and of the three kinds thereof, that is, of Proportion Arithmetical, Geometricall, and Muſicall. Then I ſhew how to finde out the ſquare root of any number, and alſo the uſe thereof, in ſetting of Battels, and alſo how to finde out the cubique root of any number: and laſt of all I treat of Aſtronomicall fractions, ſhewing how to adde, to ſubtract, to multiply, and divide the ſame, and alſo to take the ſquare root thereof, without the knowledge of which Fractions, you can never calculate any thing truly out of the Aſtronomicall Tables.

Some perhaps do looke here that I ſhould ſpeake ſomwhat of the rules of Algebra, wherby all ſubtle and intricate queſtions

of

of Arithmetick are to be unfolded, wherwith I leave indeed to deale, partly for that I have not of long time exercised my selfe therin, and partly because I know that one hath begun to write thereof, whose Booke being once ended, I doubt not but that he will shortly after print they same to the great profit and furtherance of all those that delight in such good exercises. But in the meane time I have thought good to adde (as I have said before) unto this Arithmeticke a plaine descripiion, together with the use of the Tables of Sines, of Lines Tangent and Secant, which Tables will pleasure many that would gladly know how, and wherein to use them, and specially such Seamen as have some taste of Arithmeticke, without the which no good almost is to be done in any Science.

The

The Treatiſe of Arithmeticke containeth 26 Chapters, as followeth.

WHat Arithmeticke is, what Numeration is, and of what parts it conſiſteth, and what ſignification every Digit hath according to his place, and how to expreſſe or tell a great number written in many figures, *Chap.* 1

Of the foure ſpeciall kindes of Arithmeticke, and firſt of Addition, with examples thereof, *Chap.* 2

Of Subtraction, with examples thereof, and how to try the ſame *Chap.* 3

Of Multiplication and certaine Tables belonging thereunto, together with the uſe thereof, and what is to be obſerved therein, with examples and tryall thereof, *Chap* 4

Of Diviſion, and what is to be obſerved therein, with examples and tryall thereof, and of halfing any number, *Chap.* 5

Of the rule of three, called the Golden rule, and what order is to be obſerved in working thereby, and of the three kinds thereof, *Chap.* 6

Of Fractions what they be, with a demonſtration thereof, together with ſeven neceſſary rules belonging to the ſame, and what every rule teacheth, *Chap.* 7

Of Addition, Subtraction, Multiplication, and Diviſion of Fractions, *Chap.* 8

Of the common rule of three belonging to Fractions, with examples, *Chap* 9

Of the rule reverſe, called in Latine, *Regula reverſa*, and the order of working thereby, with examples, *Chap.* 10

Of the double rule called in Latine, *Regula duplex*, and the order of working thereby, with examples, and in working thereby how to know when you have to uſe *Regula reverſa*, or the common rule of three, *Chap.* 11

Of the Rule of Fellowſhip, and the order of working thereby, with divers examples thereof, *Chap.* 12

Of Progreſſion, what it is, and of the two kinds thereof, that is, Arithmeticall and Geometricall, *Chap.* 13

Of

Of Addition belonging to Progreſſion Arithmeticall, and the order thereof, with examples, *Chap.*14

Of Addition belonging to Progreſſion Geometricall, and the order thereof, with examples, *Chap.*15

Of Proportion, what it is, and of the three kinds thereof, that is, Arithmeticall, Geometricall, and Muſicall, *Chap.*16

Of Arithmetical Proportion, what it is, and how it is divided, *Chap.*17

Of Proportion Geometricall, what it is, and how it is divided, *Chap.*18

Of the chiefe and ſpecial kinds of Geometrical Proportion, that is, of equality and inequality both greater and leſſer, *Chap.* 19

Of Proportion of the greater inequality, and of the two kinds thereof, that is, *Simplex*, and *Multiplex*, and of their divers kinds, with certaine tables belonging thereunto, *Chap.*20

Of Proportion of the leſſer inequality, *Chap.*21

Of Muſicall Proportion, what it is, and of the two kinds thereof, that is, Simple and Compound, of which Compound there be alſo two kinds, that is, proper and unproper, *Chap.*22

How Proportions are to be ſet down in writing, and how they are to be added, ſubtracted, multiplyed, and divided, even like to fractions in all reſpects, *Chap.* 23

How to finde out the ſquare root of any number, with examples, *Chap.*24

The uſe of the ſquare root in ſetting of Battels, which according to the Italian uſe are to bee ſet foure manner of wayes, the order whereof is here ſet down with examples, *Chap.*25

How to finde the Cubique root of any number, and the order thereof with examples, *Chap.* 26

Of Aſtronomicall Fractions, whereto they ſerve, and how to adde, ſubtract, multiply, and to divide the ſame, *Chap.*27

How to divide ſuch fractions when the diviſor is greater than the dividend, *Chap.*28

How to take the ſquare root of Aſtronomicall Fractions, *Ch.*29

And immediately after theſe Chapters do follow the uſe of the Tables of Sines, lines Tangent, and lines Secant, before mentioned, together with the Tables themſelves.

Mr.

Mr. Blundevil His EXERCISES.

CONTAYNING

Eight Treatises.

The first Treatise.

Cahp. I.

Of Arithmetick.



What is Arithmetick?

It is the Art of counting or numbring by figures.

What is to number by figures?

It is to expresse the value of any number in his proper Characters and figures, which is called by a Latine name Numeration.

What belongeth to Numeration?

Two things, to know the shapes of the figures, and signification of their places.

How many figures are there?

These ten, 1,2,3,4,5,6,7,8,9,0, whereof the tenth made like an o, as you see here, is called a Cypher, which is no number of it selfe, but serveth only to fill up a number.

What is number?

Number

Number is a collection or summe of many ones or unities added together.

How is number divided?

Into three kinds; that is, Digit, Article, and Compound.

Which be they?

The Digit is any of the first nine Figures before set downe. Article is any number ending in a Cypher, as 10 is one Article, 20 is two Articles, 30 is three Articles, &c. Compound is that which is compounded of Article and Digit, as 13, 14, 17, 24, &c.

Shew what signification every Digit hath according to his place, and in what order such place is to be considered in expressing any number?

The order as touching the place, is to beginne at the right hand, and so to proceed towards the left hand. For any of the nine Digits whatsoever, standing in the first place, which is on the right hand, signifieth the value of himselfe only, in the second place tenne times himselfe, in the third place an hundred times himselfe, in the fourth place a thousand times himselfe, in the fifth place tenne thousand times himselfe, in the sixth place an hundred thousand times himselfe, in the seventh place a million, or thousand thousand times himselfe, in the eighth place ten millions, in the ninth place an hundred millions, in the tenth tenth a thousand millions, &c.

Doth the Cypher signifie nothing?

Alone it signifieth nothing, otherwise it maketh a place whersoever it standeth, so as it be not the outermost on the left hand: for there it hath no place at all, as here you may see in this number 04300 whereof the first Cypher on the right hand, signifieth the first place, the second Cypher the second place, but the outermost Cypher on the left hand, signifieth no place at all, because it hath no Digit standing before it towards the left hand, and therefore though in this number there be five figures, yet it signifieth no more than if there were but foure, viz. fours thousand and five hundred.

By what meanes may a great number written in many figures, be readily expressed or told?

By dividing the same into divers parts with strokes or pricks

prickes made at the end of every third figure, beginning to tell from the right hand towards the left as in this number: 4|320|570. In which, beginning with the Cypher on the right hand, I tell one, two, and three, and there make a ſtreake, and ſo proceeding forth ſtill towards the left hand, I make a ſtreake at the end of every third figure, by which ſtreakes or partitions I make them now generall numbers, and every ſtreake muſt be named by his ſeverall denomination. Notwithſtanding, in expreſſing this number being thus divided, or any other ſuch like, you muſt begin at the left hand, and ſay in this Example thus, foure Millions, three hundred twenty thouſand, five hundred and ſeventie: for by reaſon of this Diviſion, the figure 4 ſtandeth here alone, and in the firſt place, and indeed ſignifieth foure Millions, and by that meanes, you may fitly expreſſe the ſaid number in ſaying as afore, thus, foure Millions, three hundred and twentie thouſand, five hundred and ſeventie. And the better to diſcerne the Millions from the reſt in great numbers, it ſhall not be amiſſe to ſet an M ſignifying Millions, right over the head of the ſtreake which is drawne betwixt the firth and ſeventh Figures, |34|545 M |678|694, which is to be uttered thus, thirty foure thouſand, five hundred, forty five Milions, fire hundred ſeventy eight thouſand, ſix hundred ninety and foure crownes or pounds, or whatſoever other denomination or name it ſhall pleaſe you to give them.

Chap. II.

Of the foure ſpeciall kinds or parts of Arithmeticke.

Which are thoſe foure kinds?

These, Addition, Subtraction, Multiplication, and Diviſion.

Why is not Numeration alſo counted as a part?

Becauſe Numeration together with the figures and places whereof it conſiſteth, are counted rather as firſt Elements, and Principles of Arithmeticke, then as parts or ſpeciall kinds thereof.

Of Addition.

WHat is Addition?

It is that which teacheth to bring many ſeverall ſummes into one ſumme.

How is that done?

Firſt, by placing every ſeverall number one right under another, under which you muſt draw a Line: that done, you muſt adde together the numbers of the firſt ranke, beginning on the right hand with the loweſt Figure of the ſame ranke, and ſo going upward to the higheſt Figure of the ſame ranke, and ſo from ranke to ranke, till you come to the laſt, and if the ſumme of any ranke do not exceed the number of any of the foreſaid nine Digits, then ſet downe that Digit which comprehendeth that number under his proper ranke, beneath the Line, but if the ſumme of that ranke exceedeth the number of any one Digit, by reaſon that it conſiſteth of Articles and Digits, then ſet downe the Digit, and keepe the Article or Articles in your minde, to be added to the firſt Figure of the next ranke of the left hand, but if the ſumme be an even Article or Articles, then ſet downe a Cypher, keeping the number of Article or Articles in your mind, be it to one, two, or three, to be added, the next ranke: all which things you ſhall better underſtand by this example here following. As for Example, I ſpent in one yeare 125 l. in another yeare 234 l. and in another yeare 240 l. Now to know the totall ſum of all this, I place theſe ſeverall ſummes one right under another, and then I draw a Line under them as here you ſee.

	l.
	125.
	234.
	240.
	599.

Then beginning on the right hand with the loweſt Figure of the firſt ranke above the Line, I ſay that a Cypher and 4 is but 4. Againe, 4 and 5 maketh 9, which I ſet downe under the Line, then proceeding to the ſecond ranke towards the left hand, I ſay that 4 and 3 maketh 7, and 7 and 2 maketh 9, which alſo I ſet downe, then removing to the third ranke, I ſay that 2 and 2 maketh 4, and 4 and 1 maketh

maketh 5, which I also set downe as you see in the former example, so that the totall summe under the line is 599 l.

Another example having Cyphers mixt with digits.

	3047.
Here I say that 9 and 8 maketh 17, and 17 and	4508.
7 maketh 24, wherefore I set downe the digit 4, and	3049.
keepe two Articles in mind, which being added to the	10604.

lowest figure of the second ranke, which is 4, maketh 6, then 6 and 4 maketh 10, here I set downe a Cypher, keeping one Article in mind, which being added to the figure 5 of the third ranke maketh 6, which I also set downe, then I say that 3 and 4 maketh 7, and 7 and 3 maketh 10, for the which I set downe first a Cypher: and then because there is no more to bee added, I set downe on the left hand the one Article which I had in mind, so as the whole summe commeth to 10604, as in the former example.

How are pounds, shillings, pence, halfe-pence, and farthings, and all other numbers of divers Denominations to be added?

You must divide every severall name into divers columnes or spaces by themselues, and then beginning with the first on the right hand, you must adde every columne by it selfe, bringing farthings to halfe-pence, and halfe-pence to pence, pence to shillings, and shillings to pounds, setting the summe of every columne under the nether line, as you see in this example following.

l	s	d	ob.	q;
345	13	1	0	1
234	11	0	1	1
45	14	9	1	0
520	6	8	1	1
946	5	8	0	1

Here first beginning with the columne of farthings, I find therein 3 farthings which is one halfe-penny and one farthing. Wherefore I set downe the odde farthing as you see, and keepe the halfe-penny in mind: then adding the halfe-penny in mind to the lowest halfe-peny of the second columne, I say that 1 in mind and 1 maketh 2, and 2 and 1 maketh 3, then 3 and 1 maketh 4, which 4 halfe-pence, because they make just two pence, I set downe a Cypher, keeping the two pence in mind, which two pence being added to 8 maketh 10, then 10 and 9 maketh 19, and 19 and 1 maketh 20. Now because that 20 d maketh 1 shilling and 8 d, I set downe

the 8 s̄ kæping the shilling in mind, which 1 shilling being added to the 6 of the next columne maketh 7, then 7 and 4 maketh a 11, and 11 and 1 maketh 12, then 12 and 3 maketh 15, wherefore I set downe 5, kæping the Article in mind which being added to 1 of the next columne maketh 2, and 2 and 1 maketh 3, and 3 and 1 maketh 4 Articles, which 4 Articles maketh 40 s̄, which is two pound, which I kæpe in mind, and therefore I adde the 2 l̄ to the columne of pounds, saying that 2 and 5 maketh 7, and 7 and 4 maketh a 11, and a 11 and 5 maketh 16, wherefore I set downe 6. kæping the 1 Article in mind, which being added to 2 of the next columne, maketh 3, then 3 and 4 maketh 7, and 7 and 3 maketh 10, then 10 and 4 maketh 14, wherefore I set downe 4, kæping 1 Article in mind, which being added to 3 of the next columne maketh 4, then 4 and 2 maketh 6, and 6, and 3 maketh 9, which I also set downe, so as the totall summe amounteth to 946 l̄, 5 s̄. 8 d̄. no halfe-penny, one farthing, as you sæ in the former example.

How shall I know whether these severall summes bee truely added or not?

Some do teach it to be done by culling out all the nines, which way is more tedious then sure: for the surest tryall indæd is to be done by subtracting the severall summes out of the totall sum, of which subtraction wee come now to speake, for all the foure speciall kinds are tryed one by another.

Chap. III.

Of Subtraction.

What doth Subtraction teach?

It teacheth to take a lesser number out of a greater, and to sæ what remayneth.

What is to be obserued in this kind?

First, you must set downe your greater number above, and then the lesser number right under the same. As for example, I have lent to one 564 pounds, and hee hath paid me thereof 57 pounds. Here to know what remaineth, I

first

first set downe the number lent, and under that the number paid, and then draw a line as you see in this manner.

Lent.	564. l.
Paid.	57. l.

Here beginning on the right hand, I first say, take 7 out of 4, that cannot be, wherefore I take one Article of the next figure at place of the lent number, which Article being added to 4 maketh 14, then I say, take 7 out of 14 and there remaineth 7, which I set downe under the 4; then I adde that one Article which I borrowed, to the second figure of the paid number, which is 5, saying that 5 and 1 in mind maketh 6, then take 6 out of 6 and there remaineth nothing, wherefore I set downe a cypher under the 5 of the paid number, then I proceed to the third figure of the lent number, which is 5, and because I find nothing written under it, nor having in mind to take out of it, I say, take nothing out of 5, and there remaineth still 5, so as the remainder is 507 pound, as you see in this example following.

Lent.	564. l.
Paid.	57.
Remain.	507.

How shall I know whether this bee right or not?

By adding the remainder and the number paid together, the summe whereof (if you have done well) will be all one with the number lent, as in the former example, I first adde 7 and 7 together, and that maketh 14, wherefore according to the precepts of Addition before taught, I set downe 4, the figure of reckoning in mind, then I say, 1 in mind and 5 maketh 6, which I also set downe, then I say nothing and 5 is 5, which I set downe in the third place, which in all maketh 564, a number equall to the number lent, as you see here following.

Lent.	564. l.
Paid.	57.
Remaine.	507.
Proofe.	564.

You may perceive by this, that if any figure of the paid number be greater than the figure over him, out of the which it is to be subtracted, you must alwayes borrow one Article of his next fellow, to be added againe to him in his proper place. But you have remote, that having to deale with numbers of divers denominations, then in borrowing any

number, you must alwayes have respect to the denomination or name of the thing from whence you borrow, as in borrowing from shillings you borrow 12 pence and not 10, from pounds you borrow not one Article, but 2 Articles which do make 20 ſ, but when the whole number is altogether of one selfe denomination, then you must alwayes borrow one Article which is 10, to make up your number that wanteth. As you shall more plainly perceive by this example containing numbers of divers denominations, as of pounds, shillings, and pence, halfe-pence, and farthings. Suppose therefore that you have lent to one 467 l, 13 ſ, 4 d, ob, q, and he hath paid you againe thereof 89 l, 16 ſ, 9 d, ob, q. Here having set downe the summe lent in several columnes, according to their divers names, and then the summ paid: right under the same draw a line as you see in this Example following.

	l	ſ	d	ob	q
Lent.	467	13	4	1	1
Paid.	89	16	9	1	0
Remaine.	377	16	7	0	1

Here beginning with the first columne on the right hand, I say take nothing out of one, and one still remayneth, which I set downe, then proceeding to the next, I say take one out of one and nothing remaineth, wherefore I set downe a Cypher, then proceeding to the next columne, I say take 9 out of 4, that cannot be, wherefore I borrow a shilling of the next columne, that is 12 d, which being added to 4, maketh 16 pence, then I say take 9 out of 16, and there remaineth 7, which I set downe, then proceeding to the next, I adde the one shilling which I borrowed, to the 16 which maketh 17, then I say take 17 ſ out of 13 ſ, that cannot be, wherefore I borrow one pound which is two Articles of the next ranke, that is 20 ſ, which being added to the 13 ſ, maketh 33 ſ, then I say take 17 out of 33 ſ and there remaineth 16 ſ, which I set downe: then I adde the one pound which I borrowed to 9, and that maketh 10, then I say take 10 out of 7, that cannot be, wherefore I borrow one Article out of the next 6, which being added to the 7 maketh 17, then I say take 10 out of 17 and there remaineth 7, which I set downe, then the one which I borrowed, I adde to the 8 of the next ranke, and that maketh 9. Againe, I

say

say take 9 out of 6, that cannot be: wherefore borrow one Article of the next 4, which being added to 6 maketh 16, then I say take 9 out of 16 and there remaineth 7, which I set downe, then I take the one which I borrowed out of the 4, and there remaineth 3, so that the remainder is as you see in the former example, 377 l. 16 s. 7 d. no ob. one q.

How shall I try whether this be true or not?

By adding the remainder and the summe paid together, as in the former example: and of that Addition will rise, if you have done truly, a summe like in every condition to the summe lent. In making which proofe or tryall you cannot likely erre, if you remember to reduce pence to shillings, and shillings to pounds, and therefore in the columne of pence, no particular summe can bee above 11 d. nor in the columne of shillings no particular summe can bee above 19 s. for if it be 20 s. then it is a pound, and must be brought to the columne of pounds.

Chap. IIII.

Of Multiplication.

What is Multiplication.

It is the producing or bringing forth of a third number, by multiplying two other numbers the one into the other: And it consisteth of three numbers, that is, the Multiplicand, the Multiplyer, and the Product.

What signifie those names?

The multiplicand is that number which is to be multiplied, and the multiplier is that whereby the same is multiplied, and the Product is the summe of such multiplication: As for example, if I would multiply 4 by 3, as in saying three times 4 maketh 12, here the number of 4 is the multiplicand, and the number 3 is the multiplyer, and the number 12 is the Product of that multiplication.

What order is to be observed in multiplying, and how are those numbers to be set?

Before I teach you the true order of multiplying, I think it good to set you downe a Table of Multiplication, which whilst you learne perfectly by heart, you shall never multiply readily nor quickly.

The first Table of Multiplication.

2	2	4	3	5	15	4	9	36	6	8	48	9	9	81
2	3	6	3	6	18	4	10	40	6	9	54	9	10	90
2	4	8	3	7	21	5	5	25	6	10	60	10	10	100
2	5	10	3	8	24	5	6	30	7	7	49			
2	6	12	3	9	27	5	7	35	7	8	56			
2	7	14	3	10	30	5	8	40	7	9	63			
2	8	16	4	4	16	5	9	45	7	10	70			
2	9	18	4	5	20	5	10	50	8	8	64			
2	10	20	4	6	24	6	6	36	8	9	72			
3	3	9	4	7	28	6	7	42	8	10	80			
3	4	12	4	8	32									

How is this Table to be read?

In this manner: 2 times 2 maketh 4, and 2 times 3 maketh 6, and 2 times 4 maketh 8, and so forth, multiplying still one Digit by another, until you come to 100, for this Table serveth only for Digits, which may bee made to extend so farre as you will, and until you have learned the foresaid Table without Booke, you may help your selfe with this other Table of digits, made squire-wise as you see here

1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	1
	4	6	8	10	12	14	16	18	2
		9	12	15	18	21	24	27	3
			16	20	24	28	32	36	4
				25	30	35	40	45	5
					36	42	48	54	6
						49	56	53	7
							64	72	8
								81	9

In the Front of which Table are set downe the 9 Digits, beginning on the left hand, & so proceeding to the right hand, from 1 to 9. Againe on the right side of the said table are set down

the

the foresaid 9 digits, beginning above and so proceeding right downe from 1 to 9, the use whereof is thus; first seeke the digit whose multiplyed in the front, and seeke the other whereby you have to multiply the same on the right hand, & the square angle answering to these 2 digits, will shew the Product of such Multiplication. As for example, having to multiply 7 by 6, I first seeke the greater digit which is 7 in the front, & the lesser which is 6 on the right hand, the product whereof I find in the square angle answering both to 7 and to 6 to be 42, and the like is to be observed in any 2 digits that are of the like value, as 7 times 7, the Product whereof is 49. But the first table being perfectly learned without booke, whensoever you have to multiply one number by another, you must observe these rules here following.

First, that you set downe the first figure of your multiplyer right under the first figure of the number that is to be multiplyed, on the right hand, and then orderly to place the rest of the figures of your multiplyer, be they few or many, towards your left hand, directly under the rest of the figures of the number that is to be multiplyed, for if the figures stand not in order one right over another, it will breed a confusion in your working. Secondly, you must not forget to multiply all the figures of the number that is to be multiplyed, by the first figure of your multiplier, before you deale with the next multiplyer, beginning alwayes on your right hand, and so to proceed from one to another, whereby you shall make as many severall Products as there be figures in your multiplyer. Thirdly, you must remember to set downe the first figure of every severall Product, right under the figure of that multiplyer whereby you do multiply, and having ended your multiplication, draw a line under the severall products: that done, adde the severall products together according to the rules of Addition: and the summe thereof shall be the totall or generall Product of that multiplication: all which rules you shall the better understand by working this example following. Suppose then that you would know how many houres there are in a yeare, knowing first that a yeare consisteth of 365 dayes and 6 houres, here because that every naturall day containeth 24 houres comprehending both day and night, you have to multiply 365 by 24,

and

and therefore you muſt firſt ſet down 365, becauſe it is the greater number, and is the multiplicand, which muſt alwayes ſtand above, and right under that, your multiplyer which is 24, is to be ſet downe in his due place, according to the Rules before taught, thus, as you ſee here.

When ſay thus, 4 times 5 maketh 20, and having ſet downe a cypher right under the 4, keep the 2 articles in mind, then ſay 4 times 6 is 24, and 2 in mind is 26, here ſet downe 6 and keepe 2 in mind, then ſay 4 times 3 is 12, which with the 2 in mind maketh 14, here firſt ſet downe the 4 under the 3, and becauſe you can proceed no further, you muſt therefore ſet downe hard by the 4 on the left hand the one Article which you had in mind, then having cancelled the firſt figure of the multiplyer, by making a dash through it with your pen, as you ſee in the example following: Proceed with the other figure of the multiplyer, ſaying that two times 5 maketh 10, wherefore ſet downe a Cypher right under the ſaid 2 keeping the one Article in mind, then ſay 2 times 6 is 12, and one in mind maketh 13, wherefore ſet downe 3, and keepe one in mind, then ſay 2 times 3 is 6, which with one in mind maketh 7, the which you muſt ſet downe: and becauſe you have made an end of your multiplication, cancell the 2, and draw another line under the 2 ſeverall Products: that done, adde together whatſoever is contained betwixt the two lines, and you ſhall find the generall Product to bee 8760 houres, unto which adding the odde 6 houres, the number of houres contayned in the whole yeare will be 8766 houres.

365, the multiplicand.
24 the multiplyer.

The multiplicand, 365.
The multiplyer, 24.
The ſeverall Products, 1460. 730.
The generall Product or total ſumm: 8760.

How ſhall I know whether the laſt multiplication be right or not?

By dividing the generall Product by the multiplyer, for in ſo doing your Auctient will be like unto the firſt ſumme that was multiplyed, which you cannot do, untill ſuch time as you have learned to divide, and therefore having firſt ſhewed certaine compendious wayes of multiplication, I will then proceed to division.

Certaine

Certaine compendious wayes of Multiplication.

When is any ſuch way to be uſed?

When the multiplyer beginning on the right hand with one Cypher or with many, endeth on the left hand with the Digit 1, as theſe Numbers following. 10|100|1000|&c.

What is then to be done?

If you have to multiply by 10, then you have no more to do, but to ſet downe on the right hand of the number that is to bee multiplyed, one Cypher, if by a 100, then two Cyphers, if by a 1000, then 3 Cyphers, as for example: if you would multiply 365 by 10, then by ſetting downe on the right hand one Cypher, as hath beene ſaid, the Product will be 3|650, if you ſet downe two Cyphers, the Product will be 36|500, if you ſet downe three Cyphers, then the Product will be 365|2000.

What if the number do end on the left hand with any other Digit, as 2, 3, or more, as 200, 300, 400?

Then you muſt multiply the number of the multiplicand, firſt, by that Digit, and then adde to the end of the Product on the right hand all the Cyphers annexed to the ſaid Digit, as if you would multiply 365 by 200. Firſt, ſay 2 times 5 maketh 10, and 2 times 6 maketh 12, and 1 in mind is 13, and ſo to proceed in multiplying every figure of the multiplicand by 2, and you ſhall find the Product to be 730, whereunto if you adde on the right hand 2 Cyphers, the whole Product will be 73|000.

Chap. V.

Of Diviſion.

What is Diviſion.

Diviſion is that whereby any number is divided into as many parts as you will.

How many numbers are incident to Diviſion, and how are they called?

Theſe foure, that is to ſay, the number which is to be divided, which is called the Dividend, the ſecond the number, whereby

whereby you do divide, which is called the Divisor, the third number is called the Quotient, which sheweth how many times the Divisor is comprehended in the Dividend, and the fourth number is called the Remainder, if any be.

What order is to be observed in Division?

This here following; first set downe your Dividend, and directly under that, beginning on the left hand, set downe your Divisor, that is to say, the first figure of your Divisor right under the first figure of your Dividend on the left hand, and so consequently one after another proceeding towards the right hand, which is alwayes to be done so often as your Divisor doth not exceed in quantity, the figure standing right over his head: for if it do, then you must remove your Divisor one Figure further towards the right hand. As for Example; if you would divide 487 by 53, you must not set the first Figure of your Divisor which is 5, under the first Figure of your Dividend, which is but 4, but under the second Figure of your Dividend, which is 8, for you cannot take 53 out of 48, and therefore you must set the first Figure of your Divisor under the second Figure of the Dividend, and so follow on with the rest, and then draw a line, as you see here in this Example following.

The dividend. 487.

What is then to be done? The divisor. 53. (9 the quotient,

Then you must aske how many times 5 is comprehended in 48, and you shall find that 5 is comprehended in 48, 9 times, which 9 being the Quotient, must be placed on your right hand, behind a crooked line made like a halfe Moone, as you see in the Example above, then multiply the first Figure of the Divisor by the quotient 9, and the product thereof shal be 45, which being taken out of 48 there will remaine 3, which you must set down over the head of 8, and strooke out the 48, and also the first Figure of your Divisor which is 5, that done, multiply the second Figure of your Divisor which is 3, by the foresaid Quotient which is 9, and the Product thereof will be 27, which being taken out of 37 there remaineth 10, which you must set over the head of 37, and cancell the 37 and also the three beneath, as you see in this Example following.

Wherein

Wherein you ſée that the diuidend is 487, the Diuiſor 53 the quotient 9, and the remainder 10, which if you will apply to any uſe, you may imagine that there is 487 ℔. to be diuided amongſt 53 Souldiers, and by working as before, you ſhall find that euery Souldier muſt haue nine ℔, and there ſhall be remaining ten ℔, to bee diuided amongſt the foreſaid 53 Souldiers, which ten ℔, being reduced to ſhillings, may be diuided amonſt the Souldiers, as well as the pounds: As for Example, if you multiply 10 ℔ by 20 ſ, it will make 200 ſ which being diuided by 53, the firſt Diuiſor, the quotient will be 3 ſ. and the remainder 41 ſ, and that being reduced into pence, which is done by multiplying 41 by 12, the quotient will be 9 d, and the remainder 15 d, which if you multiply by 4, you ſhall reduce them to farthings, the product whereof will be 60, which product being diuided by 53, the firſt Diuiſor, you ſhall find in the quotient one farthing, and the remainder to bee $\frac{7}{53}$ of a farthing, the value of which Fraction how to find out is taught hereafter when wee come to ſpeake of Fractions. So as you ſée by this meanes that euery Souldier ſhall haue for his ſhare 9 ℔, 3 ſ, 9 d, q; and ſomewhat more, a thing of no moment.

	1	the remainder
	30	
487, the Diuiſor 53	487	(9, the quotient.
The Diuidend.	53	

How many things are to be remembred in Diuiſion.

Theſe fiue Rules here following. Firſt, that you put no number at one time in the quotient above 9. Secondly, to moderate your quotient in ſuch ſort, as hauing multiplied the firſt figure of the Diuiſor by the quotient, there may remaine ſufficient for the next figure of the Diuiſor being multiplyed by the quotient, to bee deduced out of that number which ſtandeth right ouer his head. Thirdly, that you multiply euery figure contained in the Diuiſor by the quotient. Fourthly, that if at any time in working it happeneth ſo as your Diuiſor is not comprehended in the number ouer his head, then to put a Cypher in the quotient, and to remoouе your Diuiſor one figure further towards the right hand, and that done to worke as before. Fifthly, to ſee that the laſt remainder, if there be any left, do not

not treáted in quantity the Diuisor, all which things you shall better vnderstand by this one Example following: Suppose then that you haue to diuide 819096 by 92, here hauing set downe your Dividend and Diuisor in such order as is before taught, and as you sée here in this Example.

First aske how many times 9 is in 81, and you shal find the quotient to be 8, which being multiplyed into 9 maketh 72, which if you make out of 81, there shall remayne 9, which must bée set downe ouer the head of figure 1, and cancell the said 81, together with the first figure of the Diuisor, which is 9, then say two times eight is sixtéene, which being subtracted out of 99, there remayneth 83, which you must set ouer the head of the 99, and cancell the 99 that is aboue, and also the 2 beneath, as you sée in the former Example. That done, remoue your Diuisor towards the right hand, that is to say, by setting the last figure of your Diuisor which is 2 vnder the next Cypher on the right hand, and place the first figure of your Diuisor which is 9, next to that towards the left hand: then aske how many times 9 is comprehended in 83, and you shall find 9 times, which 9 must be set downe in the quotient next to the 8, then say 9 times 9 is 81, which being taken out of 83, there remaineth 2, then hauing set downe the 2 ouer the head of 3, cancell the 83 aboue, and also the 9 beneath, then multiply the last figure of the Diuisor which is 2 by the 9 which is in the quotient, and the Product thereof is 18, which being taken out of 20, there remayneth 2, which 2 must be set downe ouer the Cypher, and the Cypher cancelled, and also the 2 beneath, as you sée in this Example following.

	8	
	83	
The Dividend.	819096	(8, the quotient.
The Diuisor.	92	

That done remoue your Diuisor one figure further towards the right hand by setting the 2 vnder the 9, which is the last

	2	
	832	
The dividend.	819096	(89.
The diuisor.	92	

figure

figure ſaue one of the Dividend, and place the firſt figure of your Diuiſor which is 9, next to that on the left hand, then aske how mane times 9 is contained in 2, and you ſhall find none, wherefore you muſt ſet downe a Cypher in the quotient, and cancell the Diuiſor, as you ſee in this example.

That done, remoue your Diuiſor againe by ſetting the 2 under the laſt figure of the dividend, and place the 9 next to that on the left hand, then aske how many times 9 is contayned in 29 and you ſhall find 3 times, which 3 you muſt ſet downe in the quotient, as you ſee in the example following, then multiply the firſt figure of your Diuiſor which is 9, by 3, and the Product thereof will bee 27. which being taken out of 29, there will remaine 2, which 2 you muſt ſet over the head of 9, and cancell the 9 aboue, together with the 9 beneath, then multiply the 3 which is in the quotient by the laſt figure of your Diuiſor which is 2, and the Product thereof will bee 6, which being taken out of 29 there remaineth 20, wherefore you muſt ſet down a Cypher over the 6, which is the laſt figure of the Dividend, and cancell the 6 aboue, and alſo the 2 beneath, and then you haue done rightly, and in ſuch order as all the former examples, and this alſo next following do plainly ſhew.

		2	
The Dividend.	8 X 9 Ø 9 6	(890	
The Diuiſor.	9 X		

For here you ſee that the dividend is 819|096. the diuiſor 92. the quotient 8903. & the remainder 20, which remaynder muſt bee ſet on the right hand of the quotient ouer the Diuiſor, having a line drawne betwixt them as you ſee in the laſt example.

		the remainder.	
		2 20	20.
The Dividend.	8 X 9 Ø 9 6	(8903	92.
The Diuiſor.	9 X	the quotient.	

How ſhall I know whether I haue diuided truely or not?

By multiplying the quotient by your Diuiſor, and by adding to the Product thereof the remaynder, for ſo ſhall you haue a number like to the firſt Dividend if you haue wrought well, if not, then your ſumme will be either more or leſſe than the Dividend.

Certaine

Certaine compendious wayes of Diuision.

IS there no ſhorter way of Diuiſion.

No, unleſſe the Diuiſor hath one Cypher or more on the right hand, for then you may uſe a briefer way by cutting off the laſt figure, or figures of the dividend: As for example, if you had to divide 3708, by 10, here cut off the laſt figure 8 with a daſh of your Pen in this wiſe 370|8 and the quotient will bee 370, and the remainder ſhall be 8. Againe, if you had to divide the foreſaid number by 100, then cut of the two laſt figures of dividend, that is, the 8, and the Cypher ſtanding next it, and then the quotient will be but 37, and the remainder 8, as before, but if you haue to divide any number by 1000, then you muſt cut of three figures of the dividend, and ſo forth, remembring alwaies for every Cypher in the Diuiſor, to cut off one figure or Cypher of the dividend.

Of halfing any Number.

HOw is that done?

By dividing the number by 2. As for example, if you would know the halfe of 3708, divide the ſame by 2, and you ſhall find the quotient to be 1854, which is the juſt one halfe of the dividend.

CHAP.

CHAP. VI.

Of the Rule of proportion, otherwise called the golden Rule, or Rule of Three, whereof there be three kinds, that is, The common Rule Direct, the Rule Reverse, and the Double Rule.

WHerefore is it called the Rule of Three.

Because that by three knowne numbers, it teacheth you to find out a fourth number unknowne.

How are such three numbers to be placed?

The first is to be placed on the left hand, the third on the right hand, and the second in the middest betweene both.

How shall I know in what place each one is to be set?

By marking to what number the question is annexed, for that must alwayes bee the third number, and having the third number, you shall quickly have the first, because the first and third must alwayes be of one selfe Denomination or name, betweene which two, the second number is to bee placed: As for example, let this bee the question: If I pay 35 s for 13 yards of linnen cloath, how much shall I pay for 3 yards, here because the question is annexed to the number 3 yards, that must be the third number, and is to be placed on the right hand, then because that the number 13 yards is of the selfe-same Denomination, that must be the first number, and is to be placed on the left hand, and the number 35 s (which is the price) is to bee placed in the middest betwixt the other two, as you see here following.

	yards.	s.	yards.
Now must you make your question in this manner, if 13 yards did cost me 35 s,	13.	35.	3.

what shall 3 yards cost me? and so the first and last shall be of one Denomination or name, that is to say, yards.

What order is to be observed in working by this Rule?

You muſt multiply the third and ſecond numbers the one into the other, and divide the Product thereof by the firſt, and the Quotient will ſhew you what the fourth number ſhould bee, which fourth number is alwayes of like Denomination to the ſecond or middle number, as in the former example: firſt multiply 35 by 3, and the Product will be 105, which if you divide by 15, the Quotient will be eight ſhillings, and one third of a ſhilling which is foure pence, and that is the price of three yards which is the number that you ſeeke to know. And this is the common kind of working by the Rule of three, whereof it is called the common Rule of three.

What if there be divers Denominations either of coyne, as of pounds, ſhillings, and pence; or parts of yards, as quarters, halfe-quarters, and ſuch like?

Then you muſt reduce them all to the ſmalleſt Denomination which belongeth to Fractions, whereof wee come now to treate.

CHAP. VII.

Of Fractions.

WHat are Fractions?

They are broken parts of ſome whole thing called in Latine Integrum.

What is *Integrum*?

Any thing that is whole, and not broken, or divided into parts: as one whole yard, a pound, a ſhilling.

Of how many numbers doth a Fraction conſiſt?

Of two, that is, the Numerator, and the Denominator, whereof the Numerator is alwayes ſet above, and the Denominator beneath, having a little line drawne betwixt them thus $\frac{2}{3}$ which ſignifieth one ſecond or one halfe: againe, two thirds and three fourths are written thus $\frac{2}{3}$ $\frac{3}{4}$ whereof the firſt ſignifieth two thirds, and the other three fourths and ſuch like.

What

What is meant by these two words, Numerator and Denominator, and whereto serve they?

The Denominator is as much to say as the namer of the parts, which sheweth into how many parts the Integrum is to be divided, and the Numerator is as much to say as the numberer, and sheweth how many of those parts are to be taken: As for example, $\frac{2}{3}$ of a shilling; here the nethermost called the Denominator, sheweth that the shilling is to be divided into three parts, as into three groats, and the upper number called the Numerator, sheweth that you must take 2 out of those 3 parts, so as $\frac{2}{3}$ of a shilling is as much to say, as two groats or 8 d. Againe, fractions may bee divided into two kinds, that is, into simple fractions, and into fractions of fractions.

Define those two kinds?

Simple fractions are such as I speake of before, which are the first and immediate parts of any integrum that is divided into parts, but if those fractions be divided into more fractions, then are they called fractions of fractions, as when I say three fourths of two thirds, of five sevenths, and such like.

How are such fractions to be set downe in writing?

In manner of simple fractions thus, $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{5}{7}$.

Make some Demonstration of this example, that I may the better understand it?

Imagine that there is a whole peece of gold of 7 s, as our angell in times past hath beene, which 7 s bee the seven parts of that peece of gold, for tryall whereof lay downe before you 7 twelue-penny peeces of silver, or in stead thereof 7 counters, to signifie those seven parts, of which seven parts you must first take away five, rejecting or laying aside the odde seventh part, then divide those 6 parts into three parts, and every such part will be just 2 s, of which three parts you must take away two parts, that is 4 s, rejecting the other third part which remayneth, that done, divide those two parts which you have taken away into foure parts, which is 4 s, and take three of them, rejecting the fourth part, so shall you find that $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{5}{7}$ of the forelaid peece of gold is just 3 s, and there remaineth still of the parts rejected 4 s, which being added to 3 that was taken away, do make

up again the whole integrum of 7 ℔. Notwithstanding fractions of fractions do seldome chance in the division of any number, but if they do, you must reduce them into simple fractions, before you can deale with them any manner of way, and because there are divers Rules belonging to fractions, without the knowledge whereof you can neither adde, nor subtract them, nor yet ioyne them with any integrum, I will briefly set downe here seven necessary Rules for the same.

Seven necessary Rules belonging to Fractions.

WHat doth the first Rule teach?

To bring Fractions of Fractions into proper simple Fractions.

The first Rule.

How is that done?

Thus; multiply the first numerator into the second, and if there be any more fractions, then multiply also the said Product of the first two numerators into the third numerator, and that shall be the numerator of the simple fraction: then multiply the denominators in like manner, and the summe thereof shall be the denominator of the simple fraction. As in the former example ½ of ⅓ of ⅚, here I multiply the first two numerators together, in saying two times three maketh six, now because I have a third numerator, I multiply the Product of the first two numerators, which is 6, into the third numerator which is also 6, saying 6 times 6 maketh 36, and that shall be the numerator of the simple fraction, which I set downe. Then by multiplying the three denominators in like manner, I find the denominator of the simple fraction to be 84, the which I set downe under the 36, and draw a line betwixt them, so as now I find that ½ of ⅓ of ⅚ do make 36/84 which indeed is no more but ⅜ as you shall learne hereafter by the first Rule.

What doth the second Rule teach?

To bring improper fractions being more in value then integrums into integrums.

When are fractions said to be more then integrum?

When the numerator is equal or a greater number then the denominator,

minator, or if they be both of like value as $\frac{1}{2}$ $\frac{2}{4}$ and such like, then such fraction is an even Integrum.

How shall I know how many *Integrums* such fractions as bee more then *Integrums* do containe?

By dividing the Numerator by the Denominator, and if any thing remaine, write that above the Denominator, as in this example $\frac{806}{7}$, there if you divide 806 by 7 which is the Denominator, you shall find the Quotient to containe 115 Integrums, and the remainder to be 1, which is $\frac{1}{7}$.

What doth the third Rule teach?

To bring Integrums into parts by multiplying the number of the Integrums by the Denominator of those parts, as if you would bring 64 yards into quarters, multiply 64 by 4, and there will arise thereof 256 quarters.

What doth the fourth Rule teach?

It teacheth to bring Integrums having fractions annexed to them, into one fraction.

How is that done?

Multiply the number of the Integrums by the Denominator of the fraction annexed, and then adde to the Product the Numerator of the said fraction, and that summe shall be the Numerator, under which write the Denominator aforesaid, and so you shall find that 23 Integrums having $\frac{3}{4}$ annexed thereunto shall make $\frac{95}{4}$.

What doth the fift Rule teach?

It teacheth to expresse a fraction written with many Figures, in so few as may be.

How shall I do that?

Thus, find out some number that may first divide the Numerator, and then the Denominator severally by themselves, without leaving in either of them any remainder, and the Quotient of the first division will shew the Numerator, and the Quotient of the second division will shew the Denominator, but if you cannot readily find out a number that will divide them both without leaving some remainder, then leave not to subtract the lesser number out of the greater, until you find two like numbers, by one of the which two like numbers divide the Numerator,

and also the Denominator severally as before, and the Quotient will shew that which you seeke, but if such two like numbers cannot be found, then you may assure your selfe, that the fraction cannot be written in fewer figures than they already be.

Give example of these two wayes?

For example of the first way, suppose that you would expresse $\frac{9}{12}$ in lesser numbers, here seeke out some number that may divide evenly both the Numerator, and also the Denominator, without leaving in either of them any remainder, which by dividing each of them by the number of 3 you may do: For by asking how many times 3 is contained in 9, the Quotient will be 3, and by asking how many times 3 is contained in 12, the Quotient shall be 4, so shal you find $\frac{9}{12}$ to be no more then $\frac{3}{4}$. Now for example of the second way, let $\frac{27}{81}$ be the fraction which you would set downe in fewer figures, here because you cannot readily find out a number that will evenly divide both the Numerator and Denominator, subtract the lesser out of the greater, that is to say 27 out of 81, and there will still remaine 54, from which subtract 27, and there will remaine 27, which two numbers because they are both alike, divide the Numerator and Denominator of the foresaid fraction, each of them by one of these numbers, that is to say, by 27, and the Quotient of the first division will shew you the Numerator which is 1, and the Quotient of the second division will shew you the Denominator which is 3, so as you shall find $\frac{1}{3}$ to be as much in value as $\frac{27}{81}$ and note that when there bee cyphers both in the Numerator and the Denominator standing in such sort as they may bee evenly cut off, the remainder will shew the fewest figures, wherein the fraction may bee written as $\frac{300}{1200}$ here by cutting off the two cyphers as well beneath as above the line, with a dash of your Pen in this manner $\frac{3'00'}{12'00'}$ the remainder shall bee $\frac{3}{12}$ which is as much in value as $\frac{300}{1200}$. And fractions may be set downe in minimis terminis, that is to say, in the least numbers more readily by division, then by subtraction in this manner: First divide the greater number by the lesser, and if there be any remainder left, then by that remainder divide the last Divisor that

that went next before, continuing still so to do, until nothing remaine, vntil you find such a number as will evenly divide the last Diuisor, without leaving any remainder, for that number will diuide both the Numerator and also the Denominator of the given fraction, without leaving any remainder. As for example, suppose the given fraction to be $\frac{36}{81}$ which you would set downe in minimis or smallest numbers: here having divided 36 by 15, you find the remainder to bee 6, by which 6 you have to divide againe the last Diuisor which is 15, and you shall find the remainder to be 3, which doth evenly divide 6, without leaving any remainder at all. Wherefore you may boldly say that 3 is the common Diuisor, as well to the Numerator as to the Denominator of the given fraction, for if you divide 36 by 3 you shall find in the Quotient 12, which shall be the Numerator of the new found fraction, and by dividing the Denominator of the given fraction, which is 15 by 3, you shall have in the Quotient 5, and that shall bee the Denominator of the new found fraction, so shall the new found fraction bee $\frac{12}{5}$ which is in value as much as the given fraction $\frac{36}{15}$. And you have to note that such numbers as may be evenly divided by another number without leaving any remainder, are called Compounds. But such as cannot bee divided but that there will remaine some odde vnite, those are called Primes. You have also to vnderstand that if the given fraction be such as the greater number thereof may at the first be evenly divided by the lesser number, without leaving any remainder, then the Quotient of that first division shall be the common Diuisor. As for example, let $\frac{27}{81}$ bee the given fraction, as it was in the first example that was to bee wrought by subtraction, here by dividing the greater number by the lesser, you shall find no remainder but onely 3 in the Quotient, which is the common Diuisor, for if you divide the Numerator of the given fraction 27, by 3, the Numerator of the new found fraction will be 9, and having divided the Denominator of the given fraction which is 81 by 3, the Denominator of the new found fraction will bee 27, which is no more in value but $\frac{1}{3}$ for if you divide 9 by 3, the Quotient will bee 3, and if you divide 27 by 3,

the Quotient will be 9: againe, by dividing 9 by 3, the Quotient will be 3, then aske how many times 3 is contained in 3, and there will be but 1, and by asking how many times 3 is contained in 9, you shall find 3, so as the new fraction shall bee $\frac{1}{3}$, and thus you see that $\frac{3}{9}$ or $\frac{1}{3}$ is either of them but $\frac{1}{3}$ and that the number 3 which was the first Quotient, is the common Diuisor as well to the Numerator as to the Denominator of the first given fraction. And looke as compound fractions may be set downe in minimis by division, so may compound proportions be set downe in minimis by like manner of division, as shall bee declared hereafter when we come to speake of proportions.

What doth the sixth Rule teach?

It teacheth to find out the value of the fraction of any Integrum.

How is that done?

Thus; multiply the Numerator by the next lesser knowne parts of the Integrum, and diuide the Product thereof by the Denominator, so shall you haue the value of the fraction. As for example, if you would know the value of $\frac{1}{4}$ of an angell, consider first what parts an angell hath, and you shall find the parts thereof to be 10 s. or 30 groats, here if you multiply 3 by 10 s. it will make 30 s. which being diuided by 4, you shall find in the Quotient 7 s. and the remainder to be $\frac{2}{4}$ or one halfe of a shilling, which is 6 d. Againe, if you multiply 3 by 30 groats, it will make 90 groats, which being diuided by 4, you shall find in the Quotient 22 groats, and the remainder to be $\frac{2}{4}$ or one halfe of a groat which is 2 pence, making in all 7 s. 6 d. like unto the first sum, so as you see that $\frac{1}{4}$ of an angell is 7 s. 6 d. and thus you may deale with the fractions of any other Integrum that hath knowne parts.

What doth the seuenth Rule teach?

It teacheth to bring fractions of diuers denominations to one selfe-denomination, without the which neither addition, nor subtraction of fractions can be made: As for example, if you would adde $\frac{1}{3}$ and $\frac{2}{5}$ together, you must first bring them to one selfe-denomination thus: multiply the Denominators the one into the other, and the Product thereof shall bee a common Denominator to both the fractions, wherefore say 3 times 5 doe

make

make 15, which must be reduced to their lesser all places by them selues thus, 2/3 and 4/5. Then multiply the Numerator of the first fraction into the Denominator of the second, as 2 into 5 maketh 10, which set downe over the common Denominator thus 10/15 then multiply the Numerator of the second fraction into the Denominator of the first fraction as 4 into 3, which maketh 12, and that must bee likewise set downe over the second common Denominator thus 12/15 so shall you find that 2/3 and 4/5 are all one in value with 10/15 and 12/15.

Chap. VIII.

Additions of Fractions.

How are fractions to be added together? Fractions being first brought to one Denomination are easily added, for then you have no more to do but adde the Numerators together, and to write the common Denominator under the summe of such addition, as in the former example 1/3 being added to 1/3 maketh 2/3, but if the Denominators be not like, then you must make them like by the seventh Rule before taught.

What if there be three fractions of divers denominations to be added together, as 2/3 1/4 4/5.

Then having reduced the two first to one selfe-denomination, adde the two Numerators together, and write under the summe thereof the common Denominator, that done, deale with that fraction last found, and with the third as you did before with the two fractions that had divers denominations and so you shall find that 2/3 and 1/4 being first brought to one denomination, and then added together do make 11/12 whereto if you will adde 4/5 then you must bring them againe to one selfe-denomination, and so you shall find that 11/12 and 4/5 do make 55/60 and 48/60 which last two Numerators being added together do make in all 103/60 which is two Integrums and 43/60, but a more ready way is to multiply all the Denominators together into one totall or common Denominator, and then for the severall Numerators multiply each

Numerator

Numerator by all the Denominators, saving that which is under it selfe, and so is the former question performed at one worke or any such like how many soever.

Subtraction of Fractions.

HOw are Fractions to be subtracted one out of another, or out of *Integrums*?

First, make the Denominators like as you did before in Addition, then take the lesser Numerator out of the greater, and under the remainder thereof write the common Denominator, so shall you find that $\frac{3}{7}$ being taken out of $\frac{6}{7}$ there remaineth $\frac{3}{7}$, but if you would subtract fractions out of Integrums, then you must take one of the Integrums and breake it into parts. As for example, to subtract $\frac{4}{7}$ out of 9 Integrums, take one from 9, and breake it into parts making it $\frac{7}{7}$ for that is one Integrum, for when either the Numerator is made like and equall to the Denominator, it signifieth one Integrum, then take $\frac{4}{7}$ out of $\frac{7}{7}$ and there remaineth $\frac{3}{7}$ and 8 Integrums.

What is to be observed in breaking the *Integrum*?

In breaking the Integrum, you are to be directed always by the Denominator of the fraction which you have to subtract, for the Integrum which should be the Numerator, must be equall in value to the said Denominator, as before is said.

Multiplication of Fractions.

HOw are Fractions to be multiplyed by Fractions, or *Integrums* by Fractions.

As touching fractions, multiply the Numerator one into another, and the Product thereof shall bee the Numerator, then multiply the Denominators in like manner, and the Product thereof shall be the Denominator, so shall you find that $\frac{2}{3}$ being multiplyed by $\frac{4}{5}$ do make $\frac{8}{15}$. But if you would multiply Integrums by fractions, then multiply the Integrums by the Numerator of the fraction, and under the Product thereof set downe the Denominator of the same fraction, drawing a line betwixt them, so shal yo find that 20 Integrums being multiplyed by $\frac{4}{7}$ do make $\frac{80}{7}$, that is to say eight Integrums and $\frac{3}{7}$ which is $\frac{4}{7}$, etc.

Divi-

Diviſion of Fractions.

HOw are Fractions to be divided by Fractions, or *Integrums* by Fractions, or Fractions by *Integrums?*

The diviſion of fractions is done by Multiplication thus, firſt ſet downe your Dividend on the left hand, and the Diviſor alwayes on the right hand, and then draw two croſſe lines like a Saint Andrewes Croſſe betwixt them which ſhall direct you in your worſking: As for example, if you would divide $\frac{3}{2}$ by $\frac{4}{5}$ ſet them downe thus;

Dividend. Diviſor.

$\frac{3}{2} \times \frac{4}{5}$ and worke as followeth: firſt multiply the Numerator of the Dividend, by the Denominator of the Diviſor, and the Product thereof ſhall be the Numerator, then multiply the Denominator of the Dividend by the Numerator of the Diviſor, and that ſhall be the Denominator, ſo ſhall you find that $\frac{3}{2}$ being divided by $\frac{4}{5}$ the Quotient is $\frac{15}{8}$ or $1\frac{7}{8}$, but if you would divide Integrums by fractions, or contrariwiſe fractions by Integrums, then make of Integrums a fraction, by ſetting downe 1 in the place of a Denominator under the Integrums, and worke as before, ſo ſhall you find that 7 Integrums being divided by $\frac{4}{5}$ do make $8\frac{3}{4}$, contrarily if you divide $\frac{4}{5}$ by 7 Integrums, there will ariſe $\frac{4}{35}$.

What if I have to divide Fractions annexed to *Integrums?*

Then you muſt firſt reduce each Integrum with his fraction annexed, into one ſelfe-fraction by the fourth Rule of fractions before taught. As for example, if you would divide nine Integrums having $\frac{3}{4}$ thereunto annexed, by three Integrums and $\frac{5}{7}$, here the fourth Rule of fractions teacheth you firſt to multiply the Integrum 9 by 4, which is the Denominator of the fraction annexed, the Product whereof is 36, whereunto by adding the Numerator of the ſame fraction which is 3, you ſhal make the Numerator of the Dividend to be 39, under which you muſt ſet the Denominator 4, thus $\frac{39}{4}$, and that is your whole Dividend, then having in like maner brought the diviſor which

is

is 3 Integrums and $\frac{4}{7}$ into one selfe-fraction, worke as the former Rule of division teacheth you, and you shall produce $\frac{17}{7}$ which is two Integrums and $\frac{3}{7}$.

Chap. IX.

The Rule of Three belonging to Fractions.

WHat order is to bee observed in this Rule having to deale with Fractions only?

The selfe-same order that hath beene taught before touching Integrums: for in working with fractions you must have alsa three severall numbers, and you must see that the first and third numbers bee of one selfe-denomination, and that number is to be placed alwayes in the third place whereunto the question is annexed, and then to multiply the second by the third, and to divide by the first, and so the fourth number which you seeke to know, shall appeare: As for example, if $\frac{1}{4}$ of an ell of fine Holland cost mee $\frac{2}{3}$ of an English Crowne, in value 15 groats, what shall $\frac{1}{2}$ of an ell cost me? here first you must set downe your three severall numbers in order thus: $\frac{1}{4}$ ell. $\frac{2}{3}$. $\frac{1}{2}$ ell. as the first and third may be one selfe-denomination: then multiply the second and third fraction the one into the other, which will make $\frac{2}{6}$ and that being divided by $\frac{1}{4}$ which is in the first fraction, will produce $\frac{8}{6}$ of a Crowne. Or rather by this briefe Rule multiply the Numerator of the first number given, by the Denominator of the second, and that Product by the denominator of the third number given, this Product is Denominator or Divisor. Then multiply by the Numerator of the second number given by the Numerator of the third, and the Product by the Denominator of the first number given, this Product is Numerator or Dividend. The value of which fraction if you seeke to know by helpe of the 4 Rule of fractions, teaching you to multiply the Numerator of the fraction, by the knowne parts of a Crowne, which are five shillings or fifteene groats, you shall find the value of that fraction to bee eleven groats and $\frac{4}{6}$ of a groat,

which

which is one Farthing and somewhat more, supposing the least knowne parts of the Groat to be sixteene Farthings.

Chap. X.

The golden Rule reverse, called in Latine Regula reversa, *that is to say, turned backward.*

What is the order of this Rule?

Multiply the first by the second, and divide the Product thereof by the third. Or multiply the numerator of the first by the numerator of the second, and that Product by the denominator of the third number given, this last Product is numerator or dividend. Then multiply the numerator of the third by the denominator of the second, and that Product by the denominator of the first number given, this Product is denominator or divisor; as if a penny-loafe must weigh two pound, Wheat being at three shilling a bushell, what shall a penny-loafe weigh when Wheat is at two shillings the bushell? the question must be framed thus, if three shillings require two pound weight, what shall two shillings have? then by working according to this Rule, you shall find that the penny-loafe must weigh three pound.

Another example of the same Rule.

I Would know how many yards of Bayes bearing in breadth ¾ will suffice to line seven yards of silke bearing in breadth three quarters and a halfe. Here you must frame your question thus, if ¾ and ½ require seven yards, what shal ¾ require? but because the first and third number of this question are not of one selfe-denomination by reason of the fraction annexed to the first number, you shall do well to reduce the first and third number both into halfe quarters, and then to worke as though they were all integrums, which is more easie then to make all the numbers, fractions; wherefore say thus: If seven halfe quarters do require seven yards, what shall fourteene halfe quarters require? and by working by the Rule Reverse, you shall find in the Quotient three yards of Bayes and a halfe.

Chap.

Chap. XI.

The double Rule called in Latine Regula duplex.

WHereto serves this Rule? and what order is to be observed therein?

This Rule serveth to unfold two Questions wrapt in one, as thus. If I pay 4 d for the carriage of 20 ℔ weight 30 miles, what shall I pay for the carriage of 50 ℔ weight 60 miles? Note of this and such like demands, you must make two sundry Questions, and the fourth summe of the first Question being found, shall bee the second or middle number of the second Question, wherefore frame your first Question thus, if 20 ℔ cost 4 d, what shall 50 ℔ cost? and you shall find that it will cost you 10 d, then say if 30 miles cost 10 d, what shall 60 miles cost? and you shall find that it will cost 20 d. And note that each of these two Questions is to bee wrought by the common Rule of Three, that is to say, by multiplying the second into the third, and by dividing the Product thereof by the first, and the fourth found number of the first Question must bee the second, or middle number of the second Question, as in the former example, you see that 10 d, which was the fourth found number, is here the middle number of the second Question.

Another Example.

IF 25 pound do gaine me eight pound in foure yéares, how much shall 100 pound winne one in ten yéares? both these Questions are also to be wrought by the common Rule of three. Wherefore set downe the first Question thus: if 25 pound yeldeth eight pound, what shall 100 yeld? and you shall find 32 pound: then say if foure yéares yeldeth 32 pound, what shall ten yéares yeld? and you shall find eighty pound. But note that these double Questions may bee put in such sort, as you must worke the first or second Question sometimes by the Rule Reverse.

verſe: As in this Queſtion here following: if 6 l winne eight Crownes in ten yéres, in how many yéres ſhall 3 l winne 12 Crownes? here frame your firſt Queſtion thus: if 6 l require ten yéres, how many yéres ſhall 3 l require? and in working this Queſtion by the Rule Reverſe, you ſhall find twenty yéres, then for the ſecond Queſtion ſay thus, if eight Crownes require twenty yéres, how many yéres ſhall 12 Crownes require? here if you worke by the common or direct Rule of Three, you ſhall find thirty yéres.

Another example.

IF ſeven horſes do eat 12 buſhels of Oats in twenty dayes, how many buſhels ſhall fourtéene horſes eat in fiftéene daies? here frame your firſt Queſtion thus, if ſeven horſes eat 12 buſhels, what will fourtéene horſes eat? and in working by the common or direct Rule of Three, you ſhall find in the Quotient 24 buſhels, then frame your Queſtion thus, if 20 dayes require 24 buſhels, what ſhall fiftéene dayes require? here in working by the common or direct Rule of three, you ſhall find in the Quotient eightéene buſhels.

Another Example.

IF ten Reapers reape fiftéene Acres in ſeven dayes, in how many dayes ſhall fiftéene Reapers reape twenty Acres? here frame your firſt Queſtion thus, if ten Reapers require ſeven dayes, how many dayes ſhall fiftéene Reapers require? which Queſtion muſt be wrought by the Rule Reverſe, and ſo you ſhal find foure dayes and $\frac{1}{2}$ of a day which is nine houres, then ſay, if fiftéene Acres require foure dayes and $\frac{1}{2}$ of a day, how many daies ſhal twenty Acres require? and in working this ſecond Queſtion by the common or direct Rule of three, belonging to fractions, as is before taught, you ſhall find that twentie Acres will require five dayes and $\frac{10}{11}$ of a day, which is twenty houres. But it were more eaſie in this ſecond Queſtion to reduce the dayes into houres, by multiplying the foure dayes by 24 houres, the Product whereof will be 96 houres, whereunto if you adde the odde nine houres, it will make in all 105 houres,

houres, which being multiplied by the third number of this Queſtion, which is 20, the Product ſhall be 1100 houres, which diuided by the firſt number of the ſaid Queſtion which is 15, you ſhall find in the Quotient 73 houres, which if you diuide againe by 24, you ſhall find in the Quotient 3 dayes, and the remainder to be 20 houres, which agreeth in all points with the firſt manner of working by fractions, and is the eaſier way of the two.

How ſhall I know, having to worke by this double Rule, when to uſe the Rule Reverſe.

By conſidering whether the third number requireth more or leſſe time, or of any other meaſure or quantity, as in the former Example of Dayes for mowing, the more breadth it had, the leſſe did ſerue for mowing. Againe, in the Example of gaine by yeares, of 6 £, and 3 £, you did ſee that 3 £ require more Yeares then 6 £, and therefore that firſt Queſtion was wrought by the Rule Reverſe: Alſo in this laſt Example of the Reapers, the more Reapers the leſſe time they require, and therefore that queſtion was wrought by the Rule Reverſe.

Chap. XII.

The Rule of Fellowſhip.

What doth this Rule teach?

To know the gaine or loſſe of ſuch as do make a Stocke, and do occupie together in the Trade of Merchandize: As for Example, foure Merchants did put their money in lot in this manner. The firſt brought thirty Crownes, the ſecond fifty, the third ſixty, and the fourth an hundred, and with theſe portions they gained 3000 Crownes, the queſtion is how much euery one ſhall haue to his ſhare of that gaine, according to the portion which he brought. To know this, you muſt firſt gather all the ſeuerall portions together by Addition into one Summe, and you ſhall find the Summe of the portions to bee 240 Crownes,

Crownes, then say if 240 Crownes do gaine 3000 Crownes, what shall 30 gaine, and after this manner worke by the common or direct Rule of three, with all the rest of the portions, and so you shall find that he which brought 30 ought to have 375 Crownes, and he that brought 50 ought to have 625 Crownes, and hee that brought 60 ought to have 750 Crownes, and hee that brought an hundred ought to have 1250, which maketh in all 3000 Crownes, for that is the very summe of the gaine before set downe, the order of working whereof, this figure plainly sheweth.

240 ——— 3000 ——— { 30 — 375. / 50 — 625. / 60 — 750. / 100 — 1250.

The common Diuisor which is the sum of the particular portions added together. { the generall gaine. } { the particular portiõs. } { every mans singleshare }

A like Example of losse received by Shipwrack.

THree Merchants do venture their goods in one ship, the goods of the first were worth 300 Crownes, the second 400, the third 500, there were as much goods cast out as was worth 100 Crownes, the Question is how much ouere one should lose according to his portion, here worke as before, and you shall find that every one shall lose so much as this Figure following sheweth.

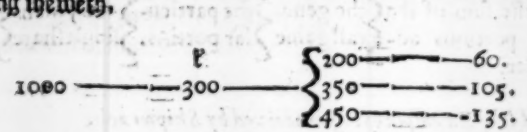
1200 ——— 100 ——— { 300 — 25. 1/3 which is fiue groats. / 400 — 33. 1/3 which is ten groats. / 500 — 41. 2/3

The common Diuisor which is the sum of the particular portions added together. { the generall losse. } { the particular portions } { every mans severall losse. }

Here to know whether the thꝛée ſeverallI loſſes do make vp the generall loſſe, do thus, firſt adde the Integrums of the ſeveral loſſes together, the ſum whereof will be 99, whereunto if you adde the two fractions which do make one whole Crowne, the ſum will be 100, a number like unto the generall loſſe.

Another Example.

THꝛée Merchants have bought 1000 l. of Pepper foꝛ thꝛée hundꝛed Crownes, the firſt taketh 200 l. the ſecond 350 l. and the third 450 l. what ſhall every man pay accoꝛding to the poꝛtion which he hath receiued, then ſay if 1000 l. be woꝛth 300 Crownes, what is 200 l. woꝛth: here woꝛking by the common oꝛ direct Rule of Thꝛée with every mans ſeverall poꝛtion receiued, you ſhall find that the firſt muſt pay 600 Crownes, the ſecond 105 and the third 135 Crownes, as this figure here following ſheweth.



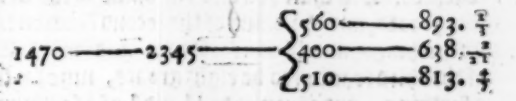
The common Diviſor. } the generall price. } the ſeveral poꝛtions receiued. } every mans particular payment.

Another like Example of divers diſtance of time.

THꝛée Merchants occupying together did gaine 2345 Crownes, the firſt put in foꝛty Crownes foꝛ the ſpace of fourteene months, the ſecond put in fifty Crownes, foꝛ the ſpace of eight months, and the third put in 85 Crownes foꝛ the ſpace of ſix months: the queſtion is, how much every one ſhall haue after the rate of his money, and accoꝛding to the quantity of time? This is to be woꝛought accoꝛding to the Rule of fellowſhip thus, multiply every mans money by his time, eyther of which, that is to ſay, the money and the time muſt be of one ſelfe Denomination, then adde the Summes of thoſe ſeverall poꝛtions

together

together, and the totall ſumme of ſuch Addition ſhall be the firſt number, and the common gaine ſhall be the ſecond number, and the third number ſhall be every mans money multiplyed by his time, then in working by the common or direct Rule of three, you ſhall find that every man ſhall have ſuch ſhare as this figure here following ſheweth.



The common Diviſor which is the totall ſumme of the ſeverall portions of mony and time added together. — the generall ſumme of the gaine. — the particular portions of the money multiplied by his time. — every mans ſingle ſhare.

Now if you would know whether the ſingle ſhares in this example do make up the generall ſumme of the gaine, then adde together the Integrums or whole ſummes of every mans ſingle ſhare, and you ſhall find the ſumme to be but 2344, which wanteth one whole Integrum of the ſecond or middle number of the queſtion, which you ſhall eaſily ſupply by adding the three ſeverall fractions together according to the Rule of Addition of fractions before taught, for ſo ſhall you find the ſaid three fractions to make in all one whole Integrum, which being added to 2344, will be anſwerable to the ſecond number of the Queſtion, which as you ſee in the Example, is 2345. And remember in adding together the ſaid three fractions, to ſet them in this order 1/7 | 3/11 | 4/7, and then to bring them to one ſelfe-denomination, as the ſeventh Rule of fractions teacheth you. But firſt becauſe you ſhall find the three remainders after the firſt three Diviſions of the three ſeverall portions made by the firſt common Diviſor of the Queſtion to be written in many figures, you muſt ſet them downe in fewer figures, according as the fifth Rule of fractions teacheth you, ſo ſhall you find the firſt remainder containing 420/1470 to be no more but 1/7, and the ſecond remainder containing 140/1470 to bee 3/11, and the third remaynder containing 840/1470 to be 4/7, which three fractions

being added together according to the seventh Rule of fractions, which will $\frac{441}{441}$ which is one whole Integrum, and must bee added by the name of 1, to the middle or second number of the question as I have said before: you may also make up the fore-said number by seeking to know the value of every fraction annexed to the Integrums, according as the first Rule of fractions teacheth, for so shall you find the value of the first fraction to be five groats, and the value of the second fraction to bee one groat six farthings, and $\frac{21}{441}$ of a farthing, and you shall find the value of the third fraction to be eight groats, nine farthings, and $\frac{1}{7}$ of a farthing, and if you adde $\frac{21}{441}$ and $\frac{1}{7}$ of a farthing together, you shall find that it will make $\frac{441}{441}$ which is one whole Integrum, or one whole farthing. Now, if you adde six, nine and one farthings together, it will make in all sixteene farthings, and that is one groat, which being added to the fourteene groats before found out, will make in all fifteene groats, which is one Crowne, and that being added to the summe 2344 will make it 2345 Crownes, which is a number agreeable to the middle summe of the question. Truly if you exercise your selfe in this and such like questions, it will make you perfect not only in Addition, Subtraction, Multiplication, and Division of whole numbers, but also of fractions, and almost in all the other Rules belonging as well to fractions, as to Integrums. Wherefore I would wish you often to use your Pen therein.

Having hitherto treated of the foure speciall kinds of Arithmeticke, that is, of Addition, Subtraction, Multiplication, and Division, as well belonging to whole numbers, as to fractions: and also shewed the use of the Golden Rule, otherwise called the Rule of Three, and of all the three kinds thereof, that is, the common Rule, the Rule Reverse, and the Double Rule, and given Examples, how and when every one is to be used, together with the Rule of Fellowship, necessary for them that use any trade of Merchandize, I thinke good now to speake somewhat of Arithmeticall and Geometricall progression, and also of proportion, and of the three kinds thereof, that is, Arithmeticall, Geometricall, and Musicall proportion, and then of the extraction of Roots both square and cubicall, and last of all, of

Astro-

Aſtronomicall fractions, ſhewing how they are to be added, ſubtracted, multiplyed, and divided.

Chap. XIII.

Of Progreſſion, and how manifold it is.

WHat is Progreſſion?

It is a certaine order of proceeding with divers Numbers, in ſuch ſort as every one may exceed each other, either by like difference of quantity, or elſe by likeneſſe of Proportion, whereof ſpringeth two kinds of Progreſſion, the one called Arithmeticall, and the other Geometricall.

What is Arithmeticall Progreſſion?

It is that which proceedeth by like difference of quantity, as thus; 3,5,7,9,11,13, whereof every one exceedeth his fellow by the difference of two.

What is Progreſſion Geometricall?

It is that wherein every number exceedeth his fellow be like Proportion, for as ſix containeth three twice, ſo doth twelve containe ſix twice, &c.

Chap. XIIII.

Of Addition belonging to Progreſſion Arithmeticall.

HOw are numbers being ſet in order according to Progreſſion Arithmeticall, to be added together, and to be reduced into one totall ſumme?

Thus, firſt ſee how many ſeverall numbers there be in all, and note the ſumme by it ſelfe, then adde the firſt number of the Progreſſion to the laſt thereof, and note that ſum by it ſelfe, that done, multiply one of theſe two reſerved ſums by the one halfe of the other, and

you ſhall haue the totall ſumme. As for Example, let theſe be your Progreſſion, 6, 10, 14|18|22|26|30|34| wherein euery number exceedeth his fellow by the difference of foure: here hauing told the numbers, I find them to be eight, which I ſet down by it ſelfe, then I adde 6, which is the firſt number, to 34, which is the laſt, and the ſumme thereof is 40, which I alſo ſet downe by it ſelfe, then in multiplying 40 by 4, which is the one halfe of 8, before ſet down: a part by it ſelfe, I find the totall ſumme of the Progreſſion to be 160.

CHAP. XV.

Of Addition belonging to Progreſſion Geometricall.

HOw are numbers being ſet in order according to Progreſſion Geometricall to be added and to be brought into one ſumme?

Thus: multiply the laſt ſumme of the Progreſſion by the number of the Proportion, wherby ſuch Progreſſion proceedeth, and from the Product of that multiplycation, ſubtract the firſt number of the Progreſſion: that done, diuide that which remayneth by a number which is leſſe than the Proportion by one, and the Quotient of ſuch diuiſion ſhall ſhew you the totall ſumme of the ſaid Progreſſion. As for Example, let this be the Progreſſion, 2, 6, 18, 54, 162, 486, 1458, the Proportion of which Progreſſion is triple, wherefore according to the Rule, I multiply the laſt number of the Progreſſion by 3, and the Product of ſuch multiplication amounteth to 4|374. out of which ſumme I ſubtract the firſt number which is 2, and there remayneth 4372, which I diuide by 2, (for it is leſſe than the Proportion 3 by 1,) and ſo I find in the Quotient 2186, which is the totall ſumme of the Proportion Geometricall.

Is there no briefer way of adding ſuch kinds of Progreſſion?

Yes indeed, but not ſo plaine as this way is, and therefore I thinke not good to trouble your memory therewith.

CHAP.

Chap. XVI.

Of Proportion.

What is Proportion?

Proportion is taken generally for the comparing of two divers quantities or numbers together, shewing what likenesse is betwixt them. But before we deale with Proportion, and with the three kinds thereof, that is, Proportion Arithmeticall, Geometricall, and Musicall: You have first to understand, that of numbers some are said to be abstract, and some concrete.

The Abstract are such as are not tyed to any Denomination, and such as are two-fold, that is, Absolute and Relative.

The Absolute are simply pronounced without having any relation to any other number, measure, or quantity, as 2, 3, 4, &c. and all numbers whatsoever, that are without Denomination, and are not attributed to any other thing.

The Relative are those which have relation one to another, which may be three manner of wayes. First in respect of difference which is found by subtraction: secondly, in respect of the Quotient found by division: thirdly, in respect of both. Of the first way springeth Arithmeticall Proportion: Of the second way Geometricall Proportion: And of the third Musicall Proportion.

Chap. XVII.

What is Arithmeticall Proportion?

Arithmeticall Proportion, unproperly so called, (because it is no Proportion indeed) is when many severall numbers have one selfe and like difference, as 8, 12, 16, which do only differ one from another by 4, and this Proportion is two-fold, that is, Continuall and Disiunct.

Continuall is, when any numbers proceed with like difference, as hath beene said before when we spake of Arithmeticall Progression, as 8, 12, 16, 20, &c. whose difference betwixt every two numbers is foure.

The Disiunct, is when many numbers being severally propounded, the difference of the first two numbers is not like to the difference that is betwixt the second and the third, and so forth, as 5, 8, 4, 7, for 8 differeth from 5 by 3, and 4 from 8, by 4, and 7 from 4 by 3. Now of the second way of comparing, which is done by division, springeth as hath beene said before, Geometricall proportion.

CHAP. XVIII.

WHat is Geometricall Proportion?

Geometricall Proportion, is that which sheweth what part or parts one number is of another number, as three is the halfe of six, which proportion is found by division, wherein you have to note, that if the Divisor be greater than the Dividend, then it is to be made a fraction, as in the former example: if you would divide three by six, then you must make it a fraction thus, $\frac{3}{6}$ or $\frac{1}{2}$, and this kind of Proportion, which may bee truly and properly called a proportion indeed, or rather a proportionality, is said to be two-fold, that is Direct, and Reverse, and the Direct is either Coniunct, or Disiunct.

Coniunct differeth not from Geometricall Progression, before taught.

Disiunct proportion Geometricall, consisting most commonly of foure numbers, or of three at the least, is when there is not like proportion betwixt the second and the third, that is, betwixt the first and the second, or betwixt the third and the fourth, as 3, 6, 4, 8, for here six containeth foure once, and one halfe thereof, which is called Proportio Sesquialtera, and six containeth three twice, which is called Proportio dupla: and so is eight to foure.

CHAP.

Chap. XIX.

AGaine, proportion Reverse differeth not from the Rule of Three, called Regula reversa. But you have to understand, that the two chiefe and speciall kinds of Geometricall proportion, are these, that is, proportion of equality, and proportion of inequality.

Proportion of equality, is when two numbers compared together, are equall the one to the other, as 3 to 3, 4 to 4.

The proportion of inequality, is when two unequall numbers are compared together, as 6 to 5, 4 to 9, and of this there are two kinds, that is, proportion of the greater inequality, and proportion of the lesser inequality.

Chap. XX.

PRoportion of the greater inequality, is when the greater number is compared to the lesser number, as six to five.

Proportion of the lesser inequality, is when the lesser is compared to the greater, as five to six.

Of proportion of the greater inequality there be two kinds, Simplex *and* Multiplex, *that is to say, simple and manifold.*

SImplex, is when the Antecedent, that is to say, the former number containeth the Consequent, that is to say, the latter number once and somewhat more, which overplus must alwayes be lesse then the Consequent it selfe, as five containeth foure once and one part thereof more, for if you divide five by foure, the Quotient will be 1, and ¼ over. Againe, this proportion is two-fold, that is, Superparticular, and Superpartient,

Super-

Superparticular, is when the Antecedent containeth the Consequent once and some one part thereof, as 3 to 2. for 3 containeth 2 once and one halfe thereof, which is called Sesquialtera, or as 4 to 3, for 4 containeth 3 once and one third part thereof and is called Sesquitertia, the like is to be said of Sesquiquarta, Sesquiquinta, Sesquisexta, and so forth infinitely, as this Table sheweth.

Superparticular proportions are these & such like.

Sesquialtera,	as 3 to 2, 6 to 4, 9 to 6,	which is as much as	$1\frac{1}{2}$
Sesquitertia,	as 4 to 3, 8 to 6, 12 to 9,		$1\frac{1}{3}$
Sesquiquarta,	as 5 to 4, 10 to 8, 15 to 12,		$1\frac{1}{4}$
Sesquiquinta,	as 6 to 5, 12 to 10, 18 to 15,		$1\frac{1}{5}$
Sesquisexta,	as 7 to 8, 14 to 12, 21 to 18,		$1\frac{1}{6}$
Sesquiseptima,	as 8 to 7, 16 to 14, 24 to 21,		$1\frac{1}{7}$
Sesquioctava,	as 9 to 8, 18 to 16, 27 to 24,		$1\frac{1}{8}$
Sesquinona,	as 10 to 9, 20 to 18, 39 to 27,		$1\frac{1}{9}$
Sesquidecima,	as 11 to 10, 22 to 20, 33 to 30		$1\frac{1}{10}$
Sesquiundeci.	as 12 to 11, 24 to 22, 36 to 33		$1\frac{1}{11}$
Sesquiduode.	as 13 to 12, 26 to 24, 39 to 36		$1\frac{1}{12}$

But Superpartient is when the Antecedent containeth the Consequent once and some parts thereof, that is to say, more parts then one, as five to three, for five containeth three once and two third parts thereof, which is called Superbipartiens tertias, of which kinds are these set downe in the Table following.

Tertias,

Proportions superpartient are these, and such like.

Superbipartiens.	Tertias, as 5 to 3, 10 to 6, 15 to 9,	which is as much as	$1\frac{2}{3}$
	Quintas, as 7 to 5, 14 to 10, 21 to 15,		$1\frac{2}{5}$
	Septimas, as 9 to 7, 18 to 14, 27 to 21,		$1\frac{2}{7}$
	Nonas, as 11 to 9, 22 to 18, 33 to 27,		$1\frac{2}{9}$
	Vndecimas, as 13 to 11, 26 to 22, 39 to 33,		$1\frac{2}{11}$
	Decim. tertias, as 15 to 13, 30 to 26, 45 to 39,		$1\frac{2}{13}$
Supertripartiens.	Quartas, as 7 to 4, 14 to 8, 21 to 12.	which is as much as	$1\frac{3}{4}$
	Quintas, as 8 to 5, 16 to 10, 24 to 15,		$1\frac{3}{5}$
	Septimas, as 10 to 7, 20 to 14, 30 to 21,		$1\frac{3}{7}$
	Octavas, as 11 to 8, 22 to 6, 33 to 24,		$1\frac{3}{8}$
	Decimas, as 13 to 10, 26 to 20, 39 to 30		$1\frac{3}{10}$
	Vndecimas, as 14 to 11, 28 to 22, 24 to 33,		$1\frac{3}{11}$
Superquadripartiens.	Quintas, as 9 to 5, 18 to 10, 27 to 15,	which is as much as	$1\frac{4}{5}$
	Septimas, as 11 to 7, 22 to 14, 33 to 21,		$1\frac{4}{7}$
	Nonas, as 13 to 9, 26 to 18, 39 to 27,		$1\frac{4}{9}$
	Vedecimas, as 15, to 11, 30 to 22, 45 to 33,		$1\frac{4}{11}$
	Decim. tertias, as 17 to 13, 34 to 26, 51 to 39,		$1\frac{4}{13}$
	Decim. quintas, as 19 to 15, 38 to 30, 57 to 45.		$1\frac{4}{15}$
Superquintupartiens.	Sextas, as 11 to 6, 22 to 12, 33 to 18,	which is as much as	$1\frac{5}{6}$
	Septimas, as 12 to 7, 24 to 14, 36 to 21,		$1\frac{5}{7}$
	Octavas, as 13 to 8, 26 to 16, 39 to 24,		$1\frac{5}{8}$
	Nonas, as 14 to 9, 28 to 18, 42 to 27,		$1\frac{5}{9}$
	Vndecimas, as 16 to 11, 32 to 22, 48 to 33,		$1\frac{5}{11}$
	Duodecimas, as 17 to 12, 34 to 24, 51 to 36.		$1\frac{5}{12}$
Supersextupartiens.	Septimas, as 13 to 7, 26 to 14, 39 to 21,	which is as much as	$1\frac{6}{7}$
	Vndecimas, as 17 to 11, 34 to 22, 51 to 33,		$1\frac{6}{11}$
	Decim. tertias, as 19 to 13, 38 to 26, 57 to 39,		$1\frac{6}{13}$
	Decim. septim. as 23 to 17, 46 to 34, 60 to 51,		$1\frac{6}{17}$
	Decim. nonas, as 25 to 19, 50 to 38, 75 to 57,		$1\frac{6}{19}$
	Vicesimas tertias, as 29 to 23, 58 to 46,		$1\frac{6}{23}$

Hitherto of Simplex proportio. Now of Multiplex proportio. Multiplex proportio is, when the Antecedent containeth the Consequent more then once, as 6 to 2, for 6 containeth 2 three times.

times which is called Tripla proportio. Also 12 to 5, for 12 comprehendeth 5 twice and $\frac{2}{5}$. And this Multiplex proportio is twofold that is, either exact or not exact.

Multiplex exact, is when the Antecedent containeth the Consequent more then once, and nothing remayneth, as 4 to 2, 6 to 3, &c. whereof are infinite kinds, as Dupla, Tripla, and so forth, as this Table sheweth.

The kinds of Multiplex exact, are these and such like.	Dupla, as 4 to 2, 6 to 3, 8 to 4,	which is as much as $\frac{1}{1}$
	Tripla, as 6 to 2 9 to 3, 12 to 4,	$\frac{2}{1}$
	Quadrupla, as 8 to 2, 12 to 3, 16 to 4	$\frac{3}{1}$
	Quintupla, as 10 to 2, 15 to 3, 20 to 4,	$\frac{4}{1}$
	Sextupla, as 12 to 2, 18 to 3, 24 to 4,	$\frac{5}{1}$
	Septupla, as 14 to 2, 21 to 3, 56 to 8,	$\frac{6}{1}$
	Octupla, as 16 to 2, 24 to 3, 32 to 4	$\frac{7}{1}$
	Nondupla as 18 to 2, 27 to 3, 36 to 4,	$\frac{8}{1}$
	Decupla, as 20 to 2, 30 to 3. 40 to 4	$\frac{9}{1}$
	Undecupla, as 22 to 2. 33 to 3, 495 to 45,	$\frac{10}{1}$

But Multiplex not exact, is when the Antecedent containeth the Consequent more then once, and something remayneth over, as 5 to 2, for 5 containeth 2 twice, and one remayneth: and this is also two-fold, that is, Multiplex supe-particularis, and Multiplex superpartiens.

Multiplex superparticularis, is when the Antecedent containeth the Consequent more then once, and one only remayneth, as 7 to 3, for 7 containeth 3 twice, and one only remayneth, whereof are divers kinds, as Duplex sesquialtera, Duplex sesquitertia, Triplex sesquisexta, and so forth, as the Table hereafter following sheweth.

But Multiplex superpartiens, is when the Antecedent containeth the Consequent more then once, and the remainder is more then 1, as 8 to 3, for 8 containeth 3 twice, and 2 thirds over, whereof there be many kinds, as Dupla superbipartiens tertias, Dupla supertripartiens quartas, and so forth, as this Table following sheweth; which comprehendeth both kinds, that is, Multiplex superparticularis, and Multiplex superpartiens.

Multiplex

Multiplex not exact, is either

- Multiplex Superparticularis or elſe
  - Duplex: Seſquialtera, as 5 to 2, 15 to 6,
    Seſquitertia, as 7 to 3, 21 to 9,
    Seſquiquinta, as 11 to 5, 22 to 10.
  - Triplex: Seſquiſexta, as 19 to 6, 38 to 12,
    Seſquiſeptima, as 22 to 7, 44 to 14,
    Seſquioctava, as 25 to 8, 50 to 16,
  - Quadruplex: Seſquinona, as 37 to 9, 148 to 36,
    Seſquidecima, as 41 to 10, 82 to 20,
    Seſquiundecima, as 45 to 11, 90 to 22

which is $2\frac{1}{2}$, $2\frac{1}{3}$, $2\frac{1}{7}$, $3\frac{1}{8}$, $3\frac{1}{7}$, $3\frac{1}{9}$, $4\frac{1}{9}$, $4\frac{1}{10}$, $4\frac{1}{11}$

- Multiplex Superpartiens.
  - Dupla.
    - Superbipartiens: Tertias, as 8 to 3, Quintas, as 21 to 5,
    - Supertripartiens: Quartas, as 11 to 4, Quintas, as 13 to 5,
    - Superquadripartiens: Quintas, as 14 to 5, Septimas, as 18 to 7.
  - Tripla.
    - Superquintupartiens: Octavas, as 29 to 8, Nonas, as 34 to 9,
    - Superſextupartiens: Vndecimas, as 39 to 11, Decim. tertias, as 43 to 13,
    - Superſeptupartiens: Octavas, as 31 to 8, Nonas, as 34 to 9,
  - Quadrupla.
    - Superbipartiens: Tertias, as 14 to 3, Quintas, as 22 to 5,
    - Superquadripartiens: Quintas, as 24 to 5, Nonas, as 40 to 9
    - Superquintupartiens: Sextas, as 29 to 6, Septimas, as 33 to 7,

which is $2\frac{2}{7}$, $2\frac{3}{7}$, $2\frac{4}{9}$, $2\frac{4}{7}$, $2\frac{5}{7}$, $2\frac{5}{9}$, $3\frac{3}{7}$, $3\frac{3}{9}$, $3\frac{6}{11}$, $3\frac{6}{13}$, $3\frac{7}{8}$, $3\frac{7}{9}$, $4\frac{2}{3}$, $4\frac{3}{5}$, $4\frac{4}{5}$, $4\frac{4}{9}$, $4\frac{5}{6}$, $4\frac{5}{7}$

Thus

Thus much of Proportion of the greater inequality: Now we will ſpeak ſomewhat of Proportion of the leſſer inequality.

Chap XXI.

Proportion of the leſſer inequality, is when the Antecedent is leſſe than the Conſequent, as 2 to 3, 5 to 7, for if you divide 2 by 3, the Quotient is $\frac{2}{3}$, if 5 by 7, then the Quotient is $\frac{5}{7}$, and this Proportion hath the ſame names which the proportion of the greater inequality hath, ſaving that you muſt adde to the beginning of every name this word Sub, as Subdupla, Subtripla, Subſeſquialtera, &c. as 1 to 2, is Subdupla Proportio, 3 to 9, is Subtripla Proportio, &c.

Chap. XXII.

Of Muſicall Proportion, called in Latine Harmoniaca Proportio.

Muſicall Proportion, which requireth three numbers at the leaſt, is when the firſt number hath the ſame Proportion unto the third, which the difference betwixt the firſt and the ſecond hath to the difference which is betwixt the ſecond and the third, as 3, 4, and 6, for looke what Proportion 3 hath to 6, which is Subdupla, the ſame hath the difference betwixt 3 and 4 which is 1, to the difference betwixt 4 and 6 which is 2, for 1 to 2 is Subdupla, and this is called Muſicall Proportion, becauſe the numbers therein have the ſame Proportions one to another, which are found to be in Muſicall Conſorts, as 6, 4 and 3, for the Proportion which 6 hath to 4, is Seſquialtera, called of the Muſitians Diapente, or a fifth, and the Proportion which 4 hath to 3, is Seſquitertia, called

of

of the Muſitians Diateſſeron, or a fourth, and the Proportion which 6 hath to 3, is Dupla, called a Diapaſon, or an eight, and of this Muſicall Proportion there be two kinds, that is, Simple and Compound.

It is ſaid to be Simple when it conſiſteth only of three numbers.

And it is called Compound when it conſiſteth of more then three numbers: And of Compound there bee two kinds, that is, unproper and proper.

The unproper is, when to 3 numbers given, 2 other ſeverall numbers are ioyned, which do containe the ſame Proportions with the third, which the firſt 3 numbers have one to another: As for example, let begiven theſe 3 numbers 3, 4, 6, unto which if you ioyne 8 and 12, here 6, 8, 12 have the ſame proportion one to another which 3, 4 and 6 have amongſt themſelves, for like as here betwixt 6 and 8 the proportion is Subſeſquitertia, and betwixt 6 and 12 it is Subdupla, and betwixt 8 and 12 it is Subſeſquialtera, ſo betwixt 3 and 4 is Subſeſquitertia, and betwixt 3 and 6 is Subdupla, and betwixt 4 and 6 is Subſeſquialtera.

Compound proper is, when divers numbers in Muſicall Proportion ſtanding together, and the firſt being omitted, the 3 next do continue ſtill in Muſicall Proportion. Alſo when omitting the 2 firſt numbers, the 3 next following are in Muſicall Proportion. And when omitting the firſt 3, the next 3 are in Muſicall Proportion, and ſo forth, how many numbers ſoever there bee: As for example, 10, 12, 15, 20, 30, theſe are numbers belonging to the proper kind of Compound Muſicall Proportion, for 10, 12, and 15, are in Muſicall Proportion, then omitting 10, which is the firſt number, 12, 15 and 20 are ſtill in Muſicall Proportion, and if you omit the 2 firſt numbers, that is, 10 and 12, then the next 3, that is 15, 20, and 30, are ſtill in Muſicall Proportion, and ſo forth, how many ſoever there be of them, ſo as they be in Muſicall Proportion: But our Muſitians do make no more but 8 Muſicall Proportions in all, that is,

Dupla.

Dupla.	which are thus named.	Diapason.
Tripla.		Diapason diapente.
Quadrupla.		Bis diapason.
Sesquialtera.		Diapente.
Sesquitertia.		Diatesseron.
Sesquiquarta.		Diatonus semitonus.
Dupla superbipartiens.		Diapason diatesseron.
Sesquioctava.		Tonus.

The use whereof is to bee learned at the hands of the Musitians.

Chap. XXIII.

But now because it is not enough to know the foresaid proportions and their names, unlesse you can both adde, subtract, multiply, and divide them when neede is, I will therefore briefly here set downe the order thereof, and first shew how to set them downe in writing, and then how they are to be added, subtracted, multiplyed, and divided.

They are to bee set downe in writing, in like manner that Fractions are wont to be set downe, saving that as in Fractions the upper number is called Numerator, and the inferior number Denominator, so in proportions the upper number is called Antecedent, and the inferior number Consequent, but whereas in Fractions, there is wont to bee drawne a little line betwixt the Numerator and the Denominator, in proportions no line is drawne betwixt the Antecedent and the Consequent, but the Antecedent is set over the Consequent, without any line drawne betwixt them thus.

And looke as Fractions are to be written in as few Figures as may be, so are proportions to be set downe in 3.|4.|2.| smal numbers as may bee, which is to bee done by the 5.|7.|1.| selfe same Rule that Fractions are.

Againe, the order of adding, subtracting, multiplying, and dividing

dividing of Proportions is much like to that of Fractions, ſaving that the adding of Proportion is to bee done in ſuch manner as Fractions are to be multiplyed, and the ſubtracting of Proportions is like to the Diviſion of Fractions, wherefore I wholly refer you to the Rules of Fractions before moſt plainly taught, and ſo I end with Proportions.

Notwithſtanding I had almoſt forgotten to ſet downe one neceſſary Rule more touching Proportions, which was alſo omitted in the firſt Impreſſion, that is, how to find out the meane Proportionall number betwixt any two numbers given, which Rule is thus: Multiply the two numbers given the one by the other, and the ſquare Root of the Product ſhall be the meane Proportionall number betwixt them. As for Example, ſuppoſe the two numbers given tobe 9, and 36, which being multiplyed the one into the other, the Product will be 324, the ſquare Root whereof is 18, and that is the meane Proportionall number betwixt the foreſaid numbers given. Now how to take the ſquare Root of any number, is plainly taught in the 24 Chapter ner following.

Chap. XXIIII.

How to find out the ſquare Root of any number.

What is a ſquare Root?

It is any Digit or any other number, which being multiplyed into it ſelfe bringeth forth a ſquare number, as 4 being multiplyed in it ſelfe, in ſaying 4 times 4 maketh 16, which is a ſquare number, the Root whereof is 4. And to find out the ſquare Root of any number be it ſquare or not ſquare, you muſt do thus: Firſt, having ſet downe the number propounded which muſt conſiſt of three figures at the leaſt, ſet a prick under the firſt Digit or Cypher of the ſaid number on the right hand, that done, prick every other figure thereof to-

wards the left hand, leaving alwayes one voyd ſpace betwixt every two pricks, as you ſee here done in this number 475645, and looke how many pricks there bee, ſo many figures ſhall you have in the Quotient, and this differeth nothing in a manner from Diviſion, the order in working is thus, firſt ſeeke out a Digit, which being multiplyed in it ſelfe, may take away that which ſtandeth over the laſt prick on the left hand, or as much thereof as may bee, and ſet the Digit in the Quotient, that done, double the ſaid Quotient, then conſider whether the double do conſiſt of one figure or of many, if of one only, then place that in the next voyd ſpace on the right hand, but if the double do conſiſt of many figures, then take the firſt figure thereof, that is to ſay, that figure or Cypher which ſtandeth in the firſt place of the double, and place that in the foreſaid next voyd ſpace towards the right hand, and next to that place all the reſt of the figures of the ſaid double orderly towards the left hand, that done, ſeeke another Digit, which being multiplyed in it ſelfe together with the double number, may take away all that which ſtandeth right over it, or as much thereof as may be, which Digit you muſt not only put in the Quotient to his fellow, but alſo ſet downe the ſame right under the next prick on the right hand, and then multiply that Digit together with the double whereto it is ioyned, by the ſaid laſt found Digit ſet downe in the Quotient, the Product whereof you muſt ſubtract out of the upper number, ſtanding right over the foreſaid prick, and if there be any remainder write it above, cancelling the other, and looke how many pricks there be, ſo many times muſt you double the Quotient, obſerving alwayes like order of working as before, which you ſhall more plainly underſtand by theſe examples following, and for your better underſtanding thereof, I will firſt give you an example of three figures only, as thus, 464, here to find out the ſquare Root of this number, you muſt firſt prick the ſaid number in ſuch order as is before taught, and then ſeeke out ſome one of the 9 Digits, which being multiplyed in it ſelfe, may take away the firſt 4 on the left hand, or as much thereof as may be, which you ſhall find to be 2, which 2 being ſet in the

Quotent,

Quotient, multiply the ſame in it ſelfe in ſaying 2 times 2 maketh 4, which 4 doth cleane take away the firſt 4 ſtanding over the laſt prick on the left hand, and therefore cancell the 4, that done, double the Quotient which maketh 4, and ſet the ſame in the nert voyd ſpace on the right hand under the figure 6 thus:

464 (2
4

And then ſeek out ſome Digit, which being multiplyed in it ſelfe together with the doubled, may take away the Summe of 64 that remayneth, which by asking how many times 4 is comprehended in 6, you ſhall find to be but 1, which you muſt not only put in the Quotient, but alſo ſet downe under the firſt prick on the right hand thus.

464 (21
41

So as you ſhall make the lower Summe to be 41 which is to be multiplyed by the laſt found Quotient which is 1, wherefore you muſt ſay that 1 time 41 is 41, which being taken out of 64, there remayneth 23, ſo as the Root is 21, and the remaynder 23, as the example ſheweth.

23

And to know whether you have done well or not, multiply the Quotient in it ſelfe, and if there be any remaynder left, adde that unto the Product of the multiplyed Quotient, and if you find the Summe thereof to be like to the firſt, then you have done well, if it be not like, then you have erred, the Product of this Quotient being multiplyed in it ſelfe amounteth unto 441, whereto by adding the remaynder which is 23, you ſhall find the Summe to be like unto the firſt number that is 464, whereof you ſought the ſquare Root. But if ſuch number do conſiſt of many figures, then in working you muſt double the Quotient once, twice, or thrice, according as the number doth require, as you ſhall more plainly perceive by this example following, as let 50467 bee the number whereof you would know the ſquare Root, here having pricked this number in ſuch order as before, firſt ſeeke out ſome Digit, which being multiplyed in it ſelfe may take away the Digit or number ſtanding right over the laſt prick on the left hand, which you ſhall find to be 2, and having ſet downe the ſaid two in the Quotient, ſay 2 times 2 maketh 4, which being

subtracted from 5, there remayneth 1 which you muſt ſet over 5, and cancell the ſaid 5, as this example ſheweth.

That done, double the Quotient, which maketh 4, and ſet downe the 4, in the nert ſpace towards the right-hand, under the Cypher, as you ſée in the former example, then ſéeke out a Digit, which being multiplyed in it ſelfe together with the double Quotient, may take away all that which ſtandeth over the ſecond prick towards the left-hand, or as much thereof as may be, which Digit by aſking how many times 4 is comprehended in 10, you ſhall find to be 2, then ſet downe the ſaid 2, not only in the Quotient, but alſo under the ſecond prick towards the right-hand, which together with the former 4, maketh 42, as you ſée in this example.

1 5·0467 (2
4
x 20
42
84.

Then multiply that 42, in a place by it ſelfe, by the figure 2 laſt ſet downe in the Quotient, and it will make 84, which 84 being taken out of 104, there remayneth 20, which you muſt ſet over the ſecond prick and cancell the 104, and alſo the 42 beneath, as you ſée in the former example: that done, double the whole Quotient, which maketh 44, whereof ſet the firſt 4 in the nert voyd ſpace towards the right-hand under the figure 6, and the other under the ſecond prick towards the left-hand, then aske how many times 4 is comprehended in 20, and you ſhall find 4, which you muſt not only ſet downe in the Quotient, but alſo under the nert and laſt prick on the right-hand, ſo the nether ſum ſhall be 444, which being multiplyed by the Digit 4 laſt ſet downe in the Quotient, will make in all 1776, which being taken out of the upper number, which is 2067, there will remaine 291, ſo as the ſquare Root of the firſt number is 224, and the remainder 291, as you may ſée in this example.

The

The ſquare Root whereof being multiplyed in it ſelfe amounteth unto 50176, whereto if you adde the remainder which is 291, the ſumme whereof will bee like unto the firſt number which is 50467.

Moreover you have to note, that if you find any number out of the which your Quotient being doubled cannot bee ſubtracted, then you muſt ſet downe a Cypher in the Quotient, and proceed to the next prick on your right hand, as in this example following.

In which example the firſt found Digit ſet in the Quotient is 6, which being multiplyed in it ſelfe maketh 36, and cleane taketh away the firſt number, ſtanding over the laſt prick on the left hand, that done, I double the Quotient, which maketh 12, and I place the 2 in the next voyd ſpace towards the right hand, and the 1 next to that towards the left hand orderly, as in this example.

Over which 12, there is but 6 remayning, ſo as I cannot take 12 out of 6, and therefore I cancell the 12, and ſet downe a Cypher in the Quotient, ſo as the Quotient is now 60 which being doubled maketh 120, the Cypher whereof I ſet downe in the next voyd ſpace on the right hand, and the other two Digits orderly towards the left hand, as you ſee in this example.

Then I aske how many times 1 is contained in 6, and I find 5, which I ſet downe in the Quotient, and alſo under the laſt prick on the right hand, ſo as the nether number is 1205, which I multiply apart by it ſelfe by the 5 laſt ſet downe in the Quotient, the Product thereof is 6025, which being taken out of the upper number which is alſo 6025, there remayneth nothing, as this example ſheweth.

Wherefore I find the foreſaid number to be a juſt ſquare number, the Root whereof is 605, which being multiplyed in it ſelfe maketh 366025, a number like unto the firſt number.

Chap. XXV.

The uſe of the ſquare Root in ſetting of battels.

THe knowledge of finding out the ſquare Root of any number, is very neceſſary for a Sargent Major in the field, that he may the more readily ſet and range his Squadranes of battell: and therefore I thinke it not amiſſe, to give them heere certaine examples of ſuch manner of ſquares as the Italians were wont to uſe in my time, which is foure manner of wayes.

Whereof the firſt teacheth how to ſet the battell ſquare of ground, the ſecond a ſquare battell of men, the third a long ſquare battell which we call the Hearſe battell, and the fourth teacheth how to ſet a battell of ſo much and a third.

Shew by what Rule theſe battels are to be ſet?

Before I ſet downe any Rules, you have to underſtand that all numbers given or ſuppoſed, are not meet for ſuch purpoſe, but only ſuch as may be divided into three equall parts, without leaving any remainder: for otherwiſe all the Rules following take no place, and therefore when any number is given you to be brought into any one of the foreſaid foure formes of battell you ſhall do well firſt to divide the number by three, and if there be any remainder, to reject it, and to take the reſt for your number. As for example, A Sargent Major is commanded by his Generall to ſet a battell ſquare of ground, appointing him thereunto 1345 men, here the Sargent by dividing that number by three, findeth in the remainder one man too many, which being only rejected, all the reſt of the number which is 1344 is fit for his purpoſe.

How

How to ſet a battell ſquare of ground, called in Italian
Battaglia quadra diterreno.

NOw ſhew the order of ſeeting ſuch kinds of battell? The order is thus, firſt double the number given, then take the ſquare Root thereof, and that Root ſhall be the Front: that done, divide the number given by the ſaid Root, and the number in the Quotient ſhall be the ſlancke, now if you multiply the Front and the ſlancke the one into the other, you ſhall have your whole number firſt given, unleſſe there be ſome remainder left in the former Diviſion, which remainder muſt be added to the Product to make up the Summe. But if you would know how many men are to bee put in a ranke, and alſo how many ſuch rankes you muſt have, then divide the Front into 3 parts, and the Quotient will ſhew you how many men you are to have in a ranke, that done, multiply the ſlancke by 3, and the Product thereof ſhall be the number of the rankes: As for example, take the number before given, which was 1345, which being divided by three, you find the remainder to bee 1, which you muſt reject, and take all the reſt which is 1344, & that being doubled maketh 2688, the ſquare Root whereof is 51, by which Root you muſt divide the number given, Videlicet 1344, and the Quotient will be 26, which ſhall be the ſlancke, now if you divide the foreſaid Front 51 by 3, the Quotient will ſhew how many ſhall be in a ranke, that is 17. Finally, if you multiply the ſlancke, which is 26 by 3, the Product thereof will be 78, which is the juſt number of the rankes which you muſt have.

How to ſet a battell ſquare of men called in Italian
Battaglia quadra d'huomini.

TAke the ſquare Root of the number given, and that ſhall be both the Front and the ſlanck, which if you multiply together the Product therof will make up the number firſt given, and if you would know how many men are to be put in a ranke,

and how many ſuch rankes you muſt have, then do as you did before in dividing the Front by 3, and multiplying the ſlancke by 3.

How to ſet a long ſquare battell which we call the Hearſe battell and is called in Italian, Battaglia dun tanto e mezzo.

TO the number given, adde the ſuſt halfe thereof, and the ſquare Roote of that ſumme ſhal be the Front, by which Roote or Front if you divide the firſt number given, the Quotient ſhall be the ſlancke: as for example, let the number given be 6144, the halfe thereof is 3072, which being added to the given number 6144, maketh in all 9216, the ſquare Roote whereof is 96, which ſhall be the Front, by which Roote or Front if you divide the given number 6144, you ſhall find in your Quotient 64, and that ſhall be the ſlancke, that done divide the foreſaid Front 96 by 3, and you ſhall find in the Quotient 32, which number ſheweth how many men ſhall be in a rancke, then multiply the foreſaid ſlancke 64 by 3, and the Product thereof ſhall be 192, which is the number of the rankes.

How to ſet a battell of ſo much and a third, called in Italian, Battaglia dun tanto & dun terzo.

TO the number given, adde the third part thereof, and the ſquare Roote of the ſumme ſhall be the Front, then divide the firſt number given by the foreſaid Roote or Front, and the number in the Quotient ſhall be the ſlancke: as for example, let the number given bee 1575, the third part whereof is 525, which being added to 1575, maketh in all 2100, the Roote whereof is 45, which muſt be the Front, by which Roote or Front if you divide the number given which was 1575, the Quotient wil be 35, which ſhall be your ſlancke, then by dividing 45, which is the Front by 3, the Quotient will ſhew you how many men you muſt have in a rancke, that is, 15. Againe by multiplying the ſlancke which is 35 by 3, the Product thereof will be 105, which is the number of your rankes.

Chap. XXVI.

How to find out the Cubique Root of any number.

As the square Root is said to be a number, which being multiplied in it selfe, doth make a square superficiall number, having only length, and breadth, so the Cubique number, is a number which being first multiplyed in it selfe, and the Product therof being againe multiplyed by the first number, doth make a Cubique or Corporall number, having both length, breadth, and depth: As for example, 2 times 2 maketh 4, and 2 times 4 maketh 8. Againe, 3 times 3 maketh 9, and 3 times 9 maketh 27, and so you may deale with all the rest of the 9 Digets, and make thereby a Table containing both the square numbers and Cubique numbers of every Root, consisting of any one of the 9 Digets, like unto this Table here following.

Roots	Squares	Cubiques
1	1	1
2	4	8
3	9	27
4	16	64
5	25	125
6	36	216
7	49	343
8	64	512
9	81	729

When having to find out the Cubique Root of any number that is greater then 1000, (for lesser it cannot be to worke upon) then set a prick under the first figure on your right hand, and so proceed towards the left hand, omitting alwayes 2 figures betwixt every two pricks, as in this example, 41063625, and looke how many pricks there be, so many figures shall you have in the Quotient: That done, you have to find out three severall numbers, first such a Cubique number as will cleane take away the number which standeth right over the head of the last pricke on

on the left hand, or so much thereof as may be, which you may easily find in the foresaid Table: The Root of which Cubique number, you must set downe in the Quotient, the second number which you have to find is a number called the Triple, which is easily had by tripling the Quotient, and the third number is called the Divisor, which you shall most readily find by multiplying the Quotient into the Triple, both which numbers are to be placed in such order as followeth. First then, having found the Cubique number, as is before said, and taken the same out of the number standing over the last prick on the left hand, write the remainder, (if there be many) over his head, cancelling that which is under it, and then place the Root of the said Cubique number in the Quotient: that done, Triple the Root set downe in the Quotient, and that shall be the Triple which you must place in the second void space on the left side of the next pricke which is on your right hand, then multiply that Triple by the Quotient, and the Product thereof shalbe the Divisor, which must be placed right under the Triple one figure shorter towards the left hand: that done, draw a line as you see in the example hereafter following, and worke thus: First aske how many times the first figure of the said Divisor is contained in the number standing right over his head: and having found an apt Digit for the purpose, put that Digit in the Quotient to his fellow: that done, multiply the said Digit into the Divisor, and set the Product thereof right under the Divisor. Secondly, multiply the said Digit in himselfe, & againe, the Product thereof into the Triple, and set the sum that comes thereof right under the Triple: Thirdly, multiply the said Digit in it selfe Cubically, and set the Product thereof lowest of all, right under the next prick on the right hand: that done, draw a line, and by addition bring all the foresaid three Products into one summe, placing every figure so as you may easily take the said sum out of the upper number, whereof you seeke the Cubique Root, and write the remainder (if there be any) over the head, and if such summe will not be subtracted out of the upper number, then you must seeke out a lesser Digit, reserving still the former Triple and Divisor, and if there be more pricks in the

number

number than two, then you must for every prick find out a new Triple and a new Divisor by tripling the whole Quotient, and by working continually in like order as the Rule before teacheth, which Rule you shall most plainly perceive by example thus: first then having to find out the Cubique Root of the number before mentioned, which is, 41063625 marked with pricks as before is taught, resort to the Table wherein you shal find such a Cubique number as will take away as much of the 41 as may be, which is 27, the Root whereof is 3, for all the other Cubique numbers in the Table are either too small or too great, and therefore you must allwayes have due consideration thereof. Then take 27 which is the Cubique number, out of 41, and there remayneth 14, which remaynder you must set over the last prick on your left hand, cancelling the 41, as in this example.

Then triple the Quotient which maketh 9, which you must set downe under the figure 6, next unto the second prick which is on your right hand: Then to find out the Divisor, multiply the Triple 9 by 3, which is the Quotient, and the product thereof shall be the Divisor: which Divisor you must place right under the Triple one figure shorter towards the left hand, that done, draw a line as you see in this example.

	14
	41063625 (3
	: . .

Now having orderly set downe the Triple and the Divisor, aske how many times 2, which is the first figure of the Divisor, is contained in 14, standing right over his head, and remember to make choyce of such a Digit, as may not cleane take away the whole number at the first, but rather leave so much as the said Quotient having afterward to be multiplyed divers wayes, as shall be said hereafter, may take away the rest or as much thereof as may be, as in this example following, you shall find the aptest Digit for this purpose to be 4, which you must put in the Quotient, whereby the Quotient shall be now 34, that done, you must first multiply this last Quotient

	14
	41063625 (3
Triple—	9
Divisor—	27

which

which is 4, into the Diviſor 27, the Product whereof is 108, which you muſt ſet downe right under the Diviſor, beneath the line already drawne, as you ſee in this example.

Secondly, you muſt multiply the ſaid 4 in it ſelfe Quadrantly which maketh 16, then multiply that 16 by the Triple 9, the Product whereof is 144, which is to be ſet right under the Triple as in this example.

Thirdly, you muſt multiply the ſaid 4 in it ſelfe Cubically, which maketh 64, which is to be ſet right under the next pitch on the right hand beneath the former ſummes, as you ſee in this other example.

So as every one of the foreſaid three Products doe extend one further then another by one Figure towards the right hand, as you ſee in the former example. Now theſe Products being thus placed, draw another line and bring all the three ſeverall Products contayned betwixt the 2 lines into one ſumme by addition, and you ſhall find the totall ſumme to bee 12304, which being ſubtracted out of the number ſtanding right over it which is 14063, there will remaine 1759, which you muſt ſet downe above as yee ſee in this example.

Now to proceed with the next: you muſt find out a new Triple and a new Diviſor.

How is that done?

	14
	4 4 4 063625 (34
Triple--	9
Diviſor--	27
	108
	14
	4 4 4 063626. (34
Triple--	9
Diviſor--	27
	108
	144
	14
	4 4 4 063625
Triple	9 1
Diviſor	27
	108
	144
	64
	12304
	1
	4 4 4 759
	4 4 4 063625 (34
Triple	9
Diviſor	27
	108
	144
	64
	12304

Thus, multiply the whole Quotient which is 34 by 3, the Product whereof is 102, and that is the Triple, which is to bee placed

placed in the next voyd space hard by the next prick that is on your right hand. Then multiply the whole Quotient into the last found Triple 102, and the Product thereof which is 3468 shall bee your Diviſor, which is to be placed under the Triple one figure ſhorter toward the left hand, as you ſee in the example following: which two numbers being thus found and rightly placed, draw a line, then aske how many times the firſt figure of your Diviſor which is 3, is contayned in the number right over his head which is 17, and you ſhall find it to be 5 times contayned therein, wherefore ſet downe 5 in the Quotient, that done, multiply 5 in the Diviſor and place the Product thereof which is 17340, right under the Diviſor beneath the line, as you ſee in this example.

Secondly, ſquare the ſame 5 that is to ſay, multiply it in it ſelfe, and that maketh 25, which 25 you muſt multiply againe into the Triple 102 the Product whereof is 2550, which number you muſt ſet right under the ſaid Triple beneath the line. Thirdly, multiply the ſaid 5 in it ſelfe Cubically, which maketh 125, and place that right under the firſt prick on the right hand, and draw a line: that done, adde all the foreſaid 3 Products together, and you ſhall find the totall ſumme thereof to bee 1759625, which being ſubtracted out of the upper number, there remayneth nothing, as this example plainly ſheweth.

Whereby you may conclude that the foreſaid number whereof you ſought the Root, is a perfect Cubique number, for if you multiply the whole Quotient in it ſelfe Cubically it will produce the ſelfe ſame number whereof you ſought the Root. But note, that if in making the firſt Subtraction, the firſt Diviſor is not to be found in the upper number, then you

```
 1
 4759
 4625(345
Triple   102
Diviſor 3468
-------------
 17340
  2550
   125
-------------
 1759625
```

you must set a Cypher in the Quotient, that done, triple the whole Quotient, and place the said Triple under the figure which is next to the next prick on the right hand, working in such order as before, and to avoid confusion, having to deale with a multitude of numbers it shall not bee amisse at the finding out of every new Triple, and Divisor, to set the remainders in severall places by themselues, and to worke then in the selfe same order that is before taught: also note that if you have to deale with a few numbers, and that the Divisor cannot bee subtracted out of the number standing right over his head, then you must set a Cypher in the Quotient, and so you have done. As for example, having to take the Cubical Root of 8597, here I find 2 to be the Quotient, which being Cubically multiplyed, doth cleane take away the 8, and now according to my former Rule 12 must be my Divisor, which because I cannot take it out of 5, I set downe therefore a Cypher in the Quotient, so as the Quotient is now 20, which is the Cubicall Root of the foresaid number, for if you multiply 20 Cubically and adde thereunto 567 which is the remaynder, the summe thereof will bee like unto the first number, as you may see in this example.

8567.

6 Triple (20 400
12 Divisor 20

20
20

8000
567
8567

Chap. XXVII.

Of Astronomicall Fractions.

Because the use of these Fractions is very necessary for those that have to calculate the motions of the Stars and the Difference of time, I thought good to shew here how the same are to bee added, subtracted, multiplyed, and divided, for the measure of Time falleth not out

out alwayes to be a whole yeare, month, day, or houre, nor the moving of the Celeſtiall bodies are to be meaſured alwayes by whole Circles, Signes, or whole Degrées, and therefore to have an exact meaſure of ſuch things it was thought beſt by the Antient Writers to divide all whole things called Integra into the leaſt parts that might be, for which purpoſe no Number was thought ſo meet as 60, for there is no number under 100, that receiveth ſo many Diviſions as 60, which may be divided many ſundry wayes, that is, by 2, 3, 4, 5, 6, 10, 12, 15, 20, and by 30, and therefore they divide every whole thing that had no uſuall parts into 60 minutes, and every minute into 60 ſeconds, and every ſecond into 60 thirds, and ſo forth into 60 fourths, fifths, ſixths, ſeventhes, eighths, ninths, and tenths, and further if need were, but that ſeldome chanceth. And you have to note that minutes are marked with one ſtrak over the head, ſeconds with two ſtrékes, thirds with three ſtrékes, and ſo forth thus, $23', 6'', 7''', 8^{iv}$, &c. which do ſignifie 23 minutes, 6 ſeconds, 7 thirds, and 8 fourths.

Of Addition.

WHat is to bee obſerved in adding of theſe kinds of Fractions?

Firſt, that you bring Integrums to Integrums, and Fractions to Fractions, that be of like Denomination, beginning alwayes with the leaſt on the right hand, and if the ſumme of ſuch Addition do amount any where to the number of 60, or above 60, then you muſt looke how many 60 are comprehended therein, and for every 60 adde one to the next greater Fraction that is on the left hand, obſerving ſtill that order untill you come to the Integrums, of which Integrums it is alſo neceſſary to know their value, that is to ſay, what parts they contayn, and what Denomination thoſe parts have. As for Example, if you adde common Signes ſuch as the 12 Signes of the Zodiake be, then every Signe containeth 30 degrées, ſo as every ſumme exceeding 30, is to be divided by 30, but if they bee

Physicall signes, whereof 6 do make a whole circle, such as be set downe in the Table of Alphonsus, then the summe of those degrees is to be divided by 6. Moreover, so often as the summe of the common signes do exceed 12, or the summe of the Physicall signes do exceed 6, the overplus is alwayes to be rejected, and the remainder to be set in the place of the signes, as you may see in this Example following, wherein Seconds are reduced to Minutes, Minutes to degrees, and finally degrees to signes.

An Example of Addition consisting of Signes, Degrees, Minutes, and Seconds.

Signes	Degrees	Minutes	Seconds
9	19	1	19
0	0	35	16
11	29	33	5
9	29	28	11
0	11	49	40
		4	56
8	0	42	27

Summa totalis.

In which Example beginning first with the seconds, because they are here the least Fractions, you shall find by addition that the summe of them amounteth to 147, which being divided by 60, you shall find in the Quotient 2, and the remainder to be 27'', which remainder you must set downe under the Collum of Seconds, keeping the Quotient which is 2 in minde to be added to the Collum of Minutes, the Summe whereof is 162, which being divided by 60, you shall find in the Quotient 2 degrees, and the remaynder to be 42' which is to be set downe under the Collum of Minutes, and the Quotient 2 kept in mind to be added to the Collum of degrees, the Summe whereof is 90 degrees, which being divided by 30, (because that 30 degrees do make one common whole signe) you shall find in the Quotient 3 signes and no remaynder: wherefore you must set downe a Cypher under the Collum of degrees, and adde three signes to the Collum of signes, the summe whereof is 32, which if you divide by twice 12, which maketh 24, you shall find the remaynder to be 8 signes, which

is

is to be set downe under the Collum of signes, for the Quotient here is to bee rejected, according to the Rule before given, so as the totall Summe of this Addition is 8 Signes, 0 Degrees, 42', 27".

Another Example of Dayes, Houres, Minutes, and Seconds, to be added together.

	Dayes	Houres	Minutes	Seconds
	21	14	32	11
	16	16	19	41
	8	16	30	30
Summa totalis.	46	23	22	22

In this Example one forme order as in the other before is to bee observed as touching the Seconds and Minutes, for the exceeding number in both, are divided by 60. but when you come to the houres, you must divide that Number by 24. because that so many houres do make a whole day, and having set downe the remaynder under the Collum of houres, adde that one day which was in the Quotient, unto the Collum of dayes, and so you shall find the totall Summe to be as the Example above sheweth.

Of Subtraction.

WHat order is to be observed in Subtraction? The selfe same that was before observed in Addition, so as you alwayes remember, that when you have to take a great number of Fractions, as of Minutes, Seconds, Thirds, and such like, out of the lesser Number of Fractions, to borrow 60, and having set downe the remaynder, to adde the one borrowed, unto the nert Collum on the left hand, for there the 60 borrowed is but one, but if you have to deale with Degrees, which are counted Integrums, then you must borrow but 30, for so many Degrees do make one Signe, and if you have to subtract houres then you must borrow 24, for so many houres do make one day, as by the Example here following, you shall more plainly perceive.

In this Example becauſe you cannot take 53″ out of 27″ you muſt borrow one minute from the next Collum on the left hand, which one minute is 60″, which being added to 27, to make in all 87″, out of which if you take 53′, there will remaine 34″, that done, you muſt pay home the minute which you borrowed by adding the ſame unto the next 9 on the left hand, which maketh 10, then ſay, take 10 out of 42′, and there remayneth 32′, which being ſet downe, proceed to the next. But here to take one out of none that cannot be, and therefore borrow one whole ſigne from the Collum of ſignes, which is 30 degrees, from whence take one and there remayneth 29, which being ſet downe, take the one which you borrowed out of 8, and there remayneth 7, ſo as the whole remaynder of this ſubtraction is 7 ſignes, 29 degrees, 32′, and 34″, as the former Example ſheweth.

Signes	Degrees	Minutes	Seconds
8	0	42	27
0	1	9	53
7	29	32	34

Multiplication.

THough there bee more difficulty in multiplying and dividing Aſtronomicall Fractions, than in adding or ſubtracting them, yet the greateſt difficulty thereof, chiefly conſiſteth in the finding out the true Denomination of the Products, for firſt as touching Multiplication, you muſt multiply every number of the multiplyer into all the particular numbers of the ſumme that is to be multiplyed, and then ſeverally to adde together the Products that be of one ſelfe Denomination, and whatſoever in that Addition ariſeth to the number of 60, or exceedeth 60, it is to be reduced by the Seragenary Diviſion into the greater ſumme, ſo ſhall you collect the whole ſumme of the multiplication. But you have to note by the way, that if there be any Integrums of divers Denominations, in your Multiplyer: That then ſuch Integrums muſt be reduced to

one

one selfe kind of Integrums: As for Example, suppose that you would multiply the daily motion of the Moone, which according to Alphonsus Tables is 13 degrees, 10′, 35″, and 1‴, by 29 dayes, 12 houres, 44′ and 3″, here because there be in this multiplyer Integrums of Divers Denominations, that is to say, dayes and houres, you must therefore reduce the same into one selfe Denomination, before that you can make your Multiplycation.

How is that to be done?

By multiplying every Number of the said Multiplyer by 5 and then by halfing the Product thereof, by which halfing you shall reduce Minutes to Seconds, and Seconds to Thirds, and so forth, to the smallest Fractions of all, and if any Product do amount to 60, or exceed 60, then you must divide the Product by 60, the remaynder whereof is to be set under his proper Denomination, and you must keepe the Quotient in mind to adde the same to the next greater Number, as this Example or Table sheweth: in the Front whereof I have set downe in severall spaces, not only the Denominations of the two Integrums, as dayes and houres, but also the Denominations of so many Fractions as I thinke meet to serve my turne, under which Front I place the foresaid Multiplyer, and then draw a Line as you see in this Example following.

Denomination.	Dayes	houres	′	″	‴	⁗
The Multiplyer to bee reduced into one selfe Denomination.	29	12	44	3		
The Products of the reduction.		29	21	50	7	30

Now beginning first on the right hand with the least Fraction of the said Multiplyer, which is 3″, I multiply 3 by 5, which maketh 15, the one halfe whereof is 7‴, and halfe a third, which is 30⁗, wherefore I set downe the sayd 7‴, and 30⁗ under their proper Denominations as you see in the Example above, then I multiply 44′ by 5, the Product whereof is 220, and the halfe thereof is 110, which being divided by 60, the Quotient is 1′, and the remaynder 50″, which remaynder I set under his proper Denomination, keeping the Quotient still in mind, that

done, I multiply 12 houres by 5, the Product whereof is 60, and the halfe of that is 30', whereunto by adding the one which I had in mind, I make it 31', and so I set it down under his proper Denomination, and because there be no more Fractions to be multiplyed, I set downe on the left hand the Integrum 29, and by this meanes I have brought the foresaid Multiplyer to one selfe Denomination and to one kind of Integrum, that is to say, to 29 dayes, 3',,50'', 7''', 30'''', which now being the greater number is to be set above, and to be multiplyed by the foresaid daily motion of the Moone, that is, 13 degrees, 10', 5'', and 1''', but to the intent that in multiplying these Numbers together, you may set every Product in his true place, that is to say, under his proper Denomination, it shall not be amisse in the Front of your worke to set downe two rowes of Numbers, whereof the first must containe so many Denominations or Fractions as you thinke good, as Minutes, Seconds, Thirds, Fourths, and so forth, marked with strokes and vulgar Numbers, and the second row shall be the naturall order of Numbers, written in Arithmeticall figures as this Table sheweth.

Integra.	' '' ''' '''' v vi vii viii	The Denominations.
0	1, 2, 3, 4, 5, 6, 7, 8,	The naturall Numbers.

Under which Table you must first set the Number that is to be multiplyed, and right under that the Multiplyer in such sort as every particular Product may be placed under his proper Denomination, and then draw a Line as you see in this Example following, and when you have multiplyed two Numbers the one into the other, and know not where to place the Product, then marke under which of the naturall Numbers in the Front, the said two Numbers, that is to say, the Multiplyer and the Multiplycand do stand: That done, adde those two naturall Numbers of the Front together, and the Summe thereof will shew you under what Denomination the Product is to be placed, as in this Example,

A

Integ.	'	''	'''	''''	v	vi	vii	Denominations.
0	1	2	3	4	5	6	7	Naturall Numbers.
29	31	50	7	20				The Multiplicand.
13	10	35	1					The Multiplyer.
			29	31	50	7	30	
		1015	1085	1750	245	1050		The severall Products.
	290	310	500	70	30			
377	403	650	9	390				The generall Product or totall Summe.
389	6	24	2	31	1	37	30	

In which Example I first multiply 1'' into 20''', the Product whereof is 30'''', which must be set under the Denomination vii, because the two naturall Numbers, that is, 3 standing over 1 the Multiplyer, and 4 standing over 30 the Multiplicand, being added together do make 7, appointing to the Product his proper Denomination, then multiply againe the same 1'', into 7''', the Product whereof is 7'''', which must be set under the Denomination vi, because 3 standeth over both their heads, and therefore must be taken 2, that is to say, for each Number 3, which being added together do make 6, appointing thereby to the Product his proper place of Denomination, that done, multiply the said 1'', into 50'', the Product whereof is 50'', which must be set under the Denomination v, for the 3 which standeth over 1, and 2 over 50'', being added together maketh 5, appointing to the Product his proper place of Denomination, then multiply the said 1'' into 31', the Product whereof is 31'', here the two naturall Numbers, that is to say, 3 standing over 1'', and 1 over 31', being added together, do make 4, appointing to the Product his proper place of Denomination, then multiply the foresaid 1'' into 29 Integrums, the Product whereof is 29'', and must be set under the Denomination '', because 3 standeth over 1'', but 29 being an Integrum, hath no naturall Number standing over him but a Cypher, thus having gone throughout al the Numbers of the Multiplicand, with the first Number of the Multiplyer, proceed in like order with the second Number of the Multiplyer, which is 35', which being multiplyed into 30'' maketh 1050'''',

to be set under the Denomination vi, because 2 standeth over 35″ the Multiplyer, and 4 over 50‴ the Multiplicand, which 4 and 2 being added together maketh 6, then multiply 35 by 7‴ which maketh 245ˣ, which you must set down under the Denomination v, because 2 and 3 maketh 5, that done, multiply 35″ by 50″, which maketh 1750ᵛⁱ, which you must set downe under the Denomination‴ because the Multiplicand and the Multiplyer are both under the Denomination″, which being twice repeated maketh 4, then multiply 35″ by 31′ and that maketh 1085‴, which you must set downe under the Denomination‴, because 1 and 2 maketh 3, finally multiply 29 Integrums by 35″, and that maketh 1015‴: thus as you have gone through with two Numbers of your Multiplyer, so proceed in like order with the other two Numbers of the Multiplyer, which is 10 and 13, and when you have ended your Multiplication, and set every Product in his proper place, and so as every figure may stand one right under another, to avoyd confusion when you come to Addition, (to which end the spaces of Collums had need to be the larger) then draw a Line under all the Products, and beginning on the right hand, adde all the Products contayned in every severall Collum together, and if the Summe of any such particular Addition do arise to the Summe of 60, or exceed the Number of 60, then divide that Summe by 60, and set downe the remaynder, keeping the Quotient in mind, to be added to the Product of the next Collum on the left hand. So shall you find the totall Summe of your multiplication to be 389 degrees, 6′, 24″, 2‴, 3ᶦᵛ, 12ᵛ, 37ᵛⁱ, and 30ᵛⁱⁱ: as the former Example plainly sheweth. Now if you divide 389 degrees by 30, because every common signe contayneth 30 degrees, you shall find your totall Sum to be 12 signes, 29 degrees, 6′, 24″, 2‴, 31ᶦᵛ, 12ᵛ, 37ᵛⁱ, and 30ᵛⁱⁱ, and so much the Moone runneth in the space of 29 dayes, 12 houres, 44′, and 3″ of an houre, which is her full resolution betwixt every two changes, but for as much as it chanceth as well in this Example as in many others like, that Integrums of two sundry Denominations are propounded in the question, it may very well be doubted with what Denomination the Product of such Multiplication is to be named, as in this

Example

Example having multiplyed Time by Motion, a man may aske whether the Product shall be named dayes, or degrees, the resolving of which doubt dependeth upon the nature of the question propounded, for in the foresaid Example, because Time of dates do comprehend any certaine appointed Motion, therefore the Product of the Multiplication is to be referred to the degrees of Motion which are comprehended under Time, and not to Time, which comprehendeth Motion, wherefore this Product of Integrums viz. 389 signifieth here degrees and not dayes, so likewise when degrees and minutes are multiplyed by myles and minutes, the Product of such Multiplication taketh his name from myles, and not from degrees, because degrees do comprehend myles, for we say in matters of Geography, that every degree of the great Circle comprehendeth 60 myles: thus having spoken sufficiently of the Multiplication of Astronomicall Fractions, we will now proceed to the Division of such Fractions.

Of the Division of Fractions Astronomicall.

WHat is to be observed therein?

First, you must consider whether your Divisor be compound, or simple, I call that compound which contayneth Fractions of divers Denominations, and that simple which consisteth of Integrums, or in one whole Number of one selfe Denomination, wherein there is no difficulty, for then you have no more to do but to divide every particular Number contayned in the Dividend by that same Divisor, and to place the Product of every one under such Denomination, as the little Table of Denominations sheweth, and therefor it shall not bee amisse to set the foresaid little Table over your Dividend even as you did in Multiplication: Also the Seragenary Progression is alwayes to be used, as well in Division as in Multiplication. Moreover, if your Divisor be not exactly contayned in the Dividend, then having multiplyed the Dividend by 60, you must adde to the Product thereof the next Fraction following: As for Example, knowing by Alphonsus Tables, that the daily Motion of the Moone is 13 Degrees, $10'$, $35''$, $1'''$, $15''''$, you

would know how much she goeth in the space of an houre, here becau'e that one day contayneth 24 houres, the number must be 24 your Divisor, which is simple and not compound: first then set downe in the Front of your worke the row of Denominations only, and not the naturall Numbers, because they are not to be used in this way of Division, that done, right under the row of Denominations, place your Dividend, and right under that your Divisor, as you see in this example.

In which example, because the Divisor 24 is not contayned in 13, therefore I multiply 13 by 60, which maketh 780, whereunto by adding the nert Fraction on the right hand, which is 10', the whole sum is 790', which being divided by 24, the Quotient is 32', which becau'e they are minutes, I place them under the Denomination of minutes, and the remainder is 22', which being multiplyed by 60, maketh 1320'', whereunto I adde the nert figure, which is 35, and so the whole summe is 1355'', which being divided by 24, the Quotient is 56'', which I place under the Denomination of seconds, and the remainder of this Division is 11'', which being multiplyed by 60, maketh 660''', whereto I adde the nert Fraction which is 1''', so that now the whole summe is 661''', which being divided by 24, the Quotient is 27''', which I set downe under the Denomination of thirds, and the remainder is 13''', which being multiplyed by 60, maketh 780'''', whereunto I adde the next Fraction, which is 15'''', which maketh in all 795'''', which being divided by 24, the Quotient is 33'''', which I place under the Denomination of fourths, and the remainder is 3'''', which being multiplyed by 60, maketh 180''''', whereunto having no Fraction to adde, I divide the same by 24, and so I find in the Quotient 7''''', which I set under the Denomination of fifths, so as I find the hourely moove of the Moone to be 32, 56'', 27''', 33'''', 7''''', and somewhat more, for I leave to deale any further with the smaller Fractions, that would still grow by multiplying the remaynders by 60, think-

Degrees	'	''	'''	''''	'''''	
13	10	35	1	15		The Denominat.
24						The Dividend.
	32	56	27	33	7	The Divisor.
						The severall sum. of every quotient.

thinking this sufficient to shew you in what order you have to worke, to divide your Dividend by a simple Divisor, into as many small parts as you will: but if your Divisor bee compound, then the Division is to be done either by Reduction into the smallest Fractions, or without Reduction: which last way is very hard and tedious, and therefore I will only shew you how to make your Division, whereof the Divisor is compound by Reduction, and that by this one Example here following. Suppose then, that the Moone according to her owne course, which is from West to East is distant from some fixed Starre 36 degrees, 30', 24'', 10''', and 15'''', and that you would know in what time she will run that distance, according to her daily moving, which as hath bin said before, is 13 degrees 10', 35'', 1''', and 15'''', here to make this Division by Reduction, you must do thus: First reduce all the numbers of your Dividend into the smallest Fractions thereof, by the Seragenary Multiplication, and Addition of the nert Fraction unto the Product of that Multiplication, that done, reduce all the numbers of your Divisor by like Multiplication and Addition into the smallest Fractions, so as the Dividend and the Divisor may bee both of one selfe Denomination, and divide the one by the other, even as they were Integrums, as in this Example you must first multiply 36 degrees by 60, and it will make 2160', whereto by adding 30', you make the whole summe of minutes to be 2190', which being multiplyed againe by 60, do make 131433'' whereto if you adde the 24'', the summe of seconds will be 131424'', and so proceeding still with the Seragenary Multiplication and Addition of the nert Fraction, as you did before, you shall find the Dividend to be 47312945'''. Then in like order reduce your Divisor into the smallest Fraction, and you shall find the totall summe thereof to be 17276075'''. This Reduction being made, divide the Dividend by the Divisor, so shall you find in the Quotient two Integrums, that is to say, two dayes, and the remainder to be 13259736'''', which remainder if you multiply by 60, and divide the Product by the selfe-same Divisor, you shall have in the Quotient minutes, then multiply againe that remainder by 60, and divide the Product thereof by the same

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Divisor, and you shall have in the Quotient seconds, and so by observing still that order, you shall bring it into as small Fractions as you will: thus shall you find that the Moone, according to her dayly Motion, will run the foresaid space of distance that was betwixt her and the fixed Starre, in two dayes, 46′, and 14″.

Chap. XXVIII.

How to divide Astronomicall Fractions, when the Divisor is greater than the Dividend.

Though by the last Chapter you may learne how to divide any number in Astronomical Fractions, whereof the Divisor is greater than the Dividend; yet I mind once againe to set down a generall Rule, to serve for such purpose, because it commeth often in use, in having to deale with Astronomicall Tables, and to give you example thereof: First then having to divide any number, whose Divisor is greater than the Dividend, do thus: multiply the greatest Denomination of the Dividend by 60, and if there be any Fractions annexed thereunto, which are of the next inferior kind, as minutes are to degrees, or to houres, and seconds to minutes, and thirds to seconds, &c. then adde them to the former Product: but if such Fractions be not of the next inferior kind, then let them stand as they are, untill you come to deale with them, and having divided according to the common Rule of Division, the first sum of the Dividend by the Divisor, multiply the Quotient into the whole Divisor, and subtract that Product out of the upper number if it may be, if not, then take the Quotient lesser and lesser, untill you can find such a number as will be subtracted out of the said upper number: and if there be any remainder left, then multiply that remainder by 60, not leaving to follow the former order of working, untill you have found the nerest exact Quotient that may be. And you have to note,

A generall Rule.

note, that the Denomination of the first Quotient must be of the next inferior kind, to that Denomination which the Divisor hath: and to mak this Rule the plainer, I will set downe an example used by Stadius in the 115 Page of his Ephemerides, who to know the very instant of the full Moone the second of March, 1569, biddeth to divide the distance of the opposition, which was 8 degrees 46′ by the diurnall excesse of the Moones Motion from the Sun, which was then 13 degrees, 48′, which Divisor, because it is greater than the Dividend, you must according to the Rule before given, work thus: First multiply the greatest Denomination of the Dividend, which is 8 degrees, by 60′, the Product whereof will be 480′, whereunto by adding the Fraction annexed, videlicet, 46′, it maketh in all 526′, which is to be divided by 13 degrees, 48′, here in dividing the last Product first by 13 degrees, I find in the Quotient 39, which is one too many, considering that I must take out of the foresaid Dividend, 48′, as often as I did take out thereof 13 degrees, wherefore I set downe but 38 in the Quotient, and then the remainder will be 96, which because I may easily divide by the common Divisor 13 degrees, and 48′, I divide therefore that 96, first by 13, whereof the Quotient is 7, and the remaynder is 5, which I reduce into seconds, by multiplying that 5 by 6, the Product whereof is 300″, that done, I multiply 48′ by 7, the Product whereof is 336, which though it be somewhat too great a number to be taken out of 300, yet I let it stand, because it approcheth to a very nigh exactnesse, and by this meanes I find the whole Quotient to bee 38′, and 7″, and you have to note, that if after the first Quotient be set downe, there happen any remainder which is lesser than the Divisor, then you must set downe a Cypher in the Quotient, and remove your Divisor one place further, even as you do in Common Division, and then to worke as before.

CHAP.

Chap. XXIX.

How to find out the ſquare Root of any Aſtronomicall Fractions.

THe greateſt difficulty hereof conſiſteth in finding out the true Denomination of the Root, for if the Fraction be ſeconds, then the Root thereof are minutes, and if the Fraction be fourths, then the Root are ſeconds, for the Fraction muſt alwayes have ſuch Denomination as may be halfed, ſeconds, fourths, and ſuch like, the one halfe whereof giveth allwayes name to the Root, for if the Quotient be of thirds, you muſt firſt reduce them to fourths, before you can take the Root, and you muſt do the like with any other Fraction, whoſe Denomination is odde and not even. As for example, if you would take the Root of 43‴, here by multiplying theſe 43‴ by 60, you ſhall reduce them into 2580‴, the Root whereof is 50″. Moreover, the Fractions wherewith you have to deale, are either ſimple or compound: if they be ſimple, and leſſe than minutes, and therewith have even Denomination, and not odde, then you need to make no further reduction, but to worke as if you had to deale with whole numbers. As in ſeeking the ſquare Root of 1600″, you find it to be juſt 40′, but if the number be compounded, that is to ſay, conſiſting of *Integrums* and Fractions, or of many Fractions having divers Denominations, then you muſt firſt reduce them all to the ſmalleſt Fraction that hath an even Denomination, before that you can take the Root. As for example, you would know the Root of 4 degrees, 25′, here you muſt by the Seragenary Multiplication, and Addition of the next Fraction reduce the degrees to minutes, and the minutes to ſeconds, as you were taught before in Diviſion, and then to worke as you were wont to do in taking the ſquare Root of whole numbers, and in ſo doing, you ſhall find the ſumme of ſeconds to be 15800″, the ſquare Root whereof is 126′, which if you divide by 60, it will make 2 degrees, 6′. Another example, as to take the Root of 13

degrees

degrées, 42', and 45'', here by reduction as before, you ſhall bring the degrées and minutes to 49365'', the ſquare Root whereof is 222', which being divided by 60, maketh 2 degrées, 42'. And thus I end with Aſtronomicall Fractions: which kind of Fractions though they be very learnedly and orderly taught by Reinoldus in the beginning of his Pruteniсall Tables, yet in mine opinion, not in ſo plaine order, and ſo fit for every mans underſtanding, as I have here ſet them downe, according to the doctrine of Gemma Friſius, which being once learned, you ſhall the ſooner attaine to the other. And without the knowledge of theſe Fractions, you can never truly calculate any thing out of the Aſtronomicall Tables, and therefore ſuch Fractions are moſt neceſſary to be learned.

Notwithſtanding, the better to calculate by the ſaid Prutenicall Tables, or by any other Aſtronomicall Tables, I muſt ſet downe here one thing more, which I had cleane forgotten in my firſt Edition, that is, to declare unto you, that in theſe Tables are often uſed two kinds of Denominations, whereof the one is called Sexagenæ, and the other Sexageſimæ, and that the Denomination Sexagenæ being ſet over any number, doth ſignifie, that the unite of the Integrum is multiplyed by 60. But the Denomination Sexageſimæ doth ſignifie, that the unite of the Integrum is divided by 60, and you have to note, that Sexagenæ have the like parts or Denominations that Sexageſimæ have, as Primes, .''. .''' and ſo forth, differing only in placing the ſaid Denominations, for the Denominations of the Sexagenæ are alwayes ſet on the left hand of their Integrums, but the Denominations of the Sexageſimæ are ſet on the right hand of their Integrums. And to eaſe you of your paine as well in multiplying and in dividing, as alſo in taking the ſquare Root of Aſtronomicall Fractions, I have thought good to ſet downe this Table here following, called the Sexagenarie Table, together with the deſcription and uſe thereof, which Table is alſo ſet downe in my firſt Edition.

The

The description and use of the *Sexagenarie Table.*

THis Table consisteth of two figures, whereof the nether figure having foure Angles, is called in Latine Trapezium, marked with the Letters A. D. E. B. and the upper figure is a Triangle, marked with the Letters A. B. C. and each figure containeth particular Columnes of Numbers, serving to find out the Product of Astronomicall Fractions, being multiplyed one by another, and also the Quotients of the like Fractions being divided one by another, and also the square Roots of the said Fractions, for which purpose, the first Columne on the left hand containeth 59 Fractions, counting from 1 standing above, and so proceeding downward to 59, and are contayned betwixt A and D, and the foot of the said Trapezium containeth 30, counting from the left hand towards the right, which are contained betwixt D and E, and the rest of the numbers to make up 59. are to be found in the uppermost Front of the Triangle, proceeding from C towards A: you have to note also, that in the uttermost Columne of the Trapezium on the right hand, the numbers do proceed downeward from 30 to 59, that is, from B to E, and the numbers in the outermost Columne of the Triangle on the right hand, do proceed upward from 31 to 59, contayned betwixt B and C, both which do serve to fill up the first multiplyers, and multiplycands, for when you cannot find them in the Trapezium, then the outermost Columne of the Triangle on the right hand serveth to supply that want, and when you cannot find the said numbers in the Triangle, then the outermost Columne of the Trapezium

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pezium on the right hand, serveth to supply that want, and in seeking any Multiplyer or Multiplicand, either in the Trapezium, or in the Triangle, consider alwayes which way they are most readily found out, so as they may directly answere one against another.

All the rest of the numbers contained betwixt the two outermost Collums and are downe in square Angles, called common Angles do signifie either Products, or Dividends, or square numbers, according as occasion shall require. And the outermost Collums do signifie sometime multiplyers, sometime multiplicands, sometime Quotients, and sometime Roots. All which things you shall better understand by the Examples hereafter following.

The use of the Table.

By helpe of this Table you may more readily multiply and divide Astronomicall fractions, and also find out the square Root of such fractions, than by those Rules which I have heretofore set downe according to the doctrine of Gemma Frisius. And first, I will set downe an Example of Multiplication, then another of Division, and thirdly, one Example of finding out the square Root of the said Fractions, & let the Example of Multiplication be thus: Suppose that you would multiply 29 Degrees, 31′, 53″, 7‴, 3⁗, 13 by degrees, 10′, 53″, 1‴, which you must set downe in such order as followeth, (that is to say) first the Denominations, then next under them the Multiplicand, and next under that the Multiplyer, and under them the severall Products, and lowest of all the totall summe of the said Products.

In.	De	′	″	‴	⁗	v	vi	vii	Denominations.
	29	31	50	7	30				Multiplicand.
	13	10	35	1					Multiplier.
				26	31	50	7	30	The 1 Product.
		17	12	34	14	22	30		The 2 Product.
	4	55	18	21	15	0			The 3 Product.
	23	52	51	37	30				The 4 Product.
6	29	9	24	2	21	12	37	30	The totall Summe.

Here beginning with the first number of the multiplier on the right hand, which is 1‴, say thus, one times 30 is 30, which is to be placed under the Denomination of

seven,

seven, because the Denomination over 7 is 3, and the Denomination over 30 is 4, which being added together according to the Rule before set downe in the Chapter of Multiplication of Astronomicall Fractions do make 7, then say one times 7 is 7, which you must place under first Denomination. Againe, one times 50 is 50, which is to be set under the fift Denomination, because 3 and 2 maketh 5, then say one times 31 is 31, which is to be set under the fourth Denomination, for 3 and 1 maketh 4, then one times 29 is 29, which is set under the third Denomination, and thus you have the first Product, then proceed with the next Number of the Multiplyer towards your left hand, which is 35, and is to be multiplyed into 30, which to do readily, you must enter the Table with these two Numbers, and seeking in the first Collum of the Trapezium, on the left hand, for 35, in the foot of the said Trapezium, for the number of 30, you shall find in the common Angle the Product to bee 17, and 30, whereof you must place the 30 under the first Denomination, and keeping the number 17 still in mind to be added to the next Product, multiply 35 into 7, and you shall find in the Trapezium the Product to be 4, and 5, whereunto if you adde the 17 which you had in mind, the Product will bee 4, and 22, whereof you must set the 22 under the fift Denomination, and keeping the 4 in mind, multiply againe the same 35 into 50, the Product whereof you shall find in the Triangle to be 29, and 10, whereto if you adde the 4 in mind, it will make 29, and 14, whereof the 14 is to bee placed under the fourth Denomination, and keeping the 29 in mind, multiply againe the said 35 into 31, and you shall find the Product thereof in the Triangle to be 18, and 5, whereunto if you adde 29 in mind, it will make in all 18, and 34, which 34 is to be set under the third Denomination, then keeping 18 in mind, multiply the foresaid 35 into 29, and you shall find the Product thereof in the Trapezium to be 16, and 55, whereunto if you adde the 18 in mind; the Product will be 17, and 13, which 13 is to be placed under the second Denomination, now because you have gone through all the numbers of the Multiplicand, with the number 35 you must place

the

the 17. which you had in mind under the Denomination of minutes, and so having ended the second Product, proceed to the finding out of the third Product by multiplying 10. first into 30. the Product whereof you shall find in the Trapezium to be 5, and 0, whereof you must set the Cypher under the fift Denomination, and keeping the 5 in mind, multiply againe 10 into 7, and you shall find the Product to be 1, and 10, whereunto if you adde the 5 in mind, the Product will be 1, and 15, whereof you must set the 15, under the fourth Denomination, and keeping the one in mind, multiply 10 into 50, and you shall find the Product thereof in the Trapezium to be 8, and 20, whereunto if you adde the 1 in mind, it will make 8, and 21, whereof you must set the 21, under the third Denomination, and keeping 8 in mind, multiply 10 into 31, and you shall find the Product thereof in the Trapezium to be 5, and 10, unto which if you adde the 8 in mind, the Product will be 5, and 18, whereof set downe the 18 under the second Denomination, and keeping 5 in mind, multiply 10 into 29, the Product whereof you shall find in the Trapezium to be 4, and 30, whereunto if you adde the 5 in mind, the Product will be 4, and 35. Now because you have gone through all the Numbers of the Multiplicand with 10, you must set downe the 4 which you had in minde under the Denomination of degrees, and so having the third Product, proceed to the fourth by multiplying 13 into 30, and you shall find the Product in the Trapezium to be 6, and 30, whereof set downe 30 under the fourth Denomination of Fractions, and keeping 6 in mind, multiply 13 into 7, the Product whereof you shall find in the Trapezium to be 1, and 31, whereunto if you adde the 6 in mind, the Product will bee 1, and 37, whereof set downe the 37 under the third Denomination, and keeping the 1 in mind, multiply 13 into 50, and you shall finde the Product in the Trapezium to be 10, and 50, whereunto if you adde the 1 in mind, the Product will be 10, and 51, whereof set the 51 under the second Denomination of Fractions, and keeping 10 in mind, multiply 13 in 31, the Product whereof you shall find in the Trapezium to be 6, and 43, whereunto if you adde the 10 in

mind, the Product will be 6, and 53, whereof set downe 53, under the first Denomination of Fractions, and keeping 6 in mind multiply 13 into 29, the Product whereof you shall find in the Trapezium to be 8, and 17, whereunto if you adde the 6 in mind, the Product will be 6, and 23, whereof set downe 23 under the Denomination of degrees. Now because you have gone through all the Numbers of the Multiplicand with the last Number of the Multiplyer, you must set downe the 6 which you had in mind under the Denomination of Integrums, that done, adde all the foure Products together, beginning on the right hand, saying thus, 30 and 0 is but 30, which set downe under the nethermost line, as you see in the former figure, then say 30 and 7 maketh 37, which you must set downe under the nethermost line next unto 30, then say 22 and 50 maketh 72, out of which by subtracting the Sexagenary Number, the remainder is 12', which is to be set under the line next unto the 37, keeping still the 60 in mind, which in this account maketh but one', and is to be added to the next ranke on the left hand, then say 1 in mind and 5 maketh 6, and 4 maketh 10, and 1 maketh 11, here set downe 1, and keepe the Article in mind, then say 1 in mind and 3 maketh 4, then 1 and 1 and 3 being added is 4, so make in all 9, out of which 9 you must subtract 6, which is but one 60, and is to be kept in mind and there remayneth 3, which is to be set downe by the 1, then say 1 in mind and 7 is 8, and 1 is 9, and 4 is 13, and 9 is 22, here set downe 2, and keepe the two Articles in mind, then say 2 and 3 maketh 5, and 2 is 7, and 3 is 10, and 2 maketh 12 tens, which do make 2 sixties, and are to be kept in mind, then say 2 and 1 maketh 3, and 8 maketh 12, and 3 maketh 14, wherefore set downe 4, keeping the 1. Article in mind, then say 1 in mind and 5 is 6, and 1 is 7, and 1 is 8, then take 6 from 8 and there remayneth 2 which set downe by the 4, and keepe one sixty in mind, then say 1 in mind and 3 is 4, and 5 is 9, and 7 is 16, wherefore set downe 6, and keeping one in mind, say that 1 and 5 is 6, and 5 is 11, and 1 is 12, which maketh two sixties to bee kept in mind, then say 2 in mind and 3 is 5, and 4 maketh 9, which set downe,

then

then say 2 is 2, which set downe by the 9, under the Denomination of degrees, then say 6 and nothing is 6, which set downe under the Denomination of Integrums, for that 6 in this place signifieth 6 signes, which is in value 360 degrees, and being divided by 30, because 30 degrees make the one whole signe, you shall find in the Quotient 12 signes, so as the totall summe of the foure Products is 12 signes, 29 degrees, 6′, 24″, 2‴, 31⁗, 12ˣ, 37ˣᴵ, 30ˣᴵᴵ. as the former Example sheweth, and this is the very same Example which I wrought before when I taught you how to multiply Astronomicall Fractions according to Gemma Frisius his Rule, and they both do wholly agree in every condition, saving that to worke by the Sexagenary Table is the readier way of the two.

An Example how to divide Astronomicall Fractions, by helpe of the Sexagenary Table.

SUppose then that you would divide the former totall Summe or Product found by Multiplication, which is 6 Integrums, 29 degrees, 6′, 24″, 2‴, 31⁗, 12ˣ, 37ˣᴵ, 30ˣᴵᴵ, by this Divisor 29 degrees, 31′, 50″, 70‴, 30⁗, which in the former Example of Multiplication, was the Multiplicand. Now to Divide these two Numbers the one by the other, you must do thus; first you must set downe the row of Denominations, as you did before in Multiplication, and next under that the Dividend, then right under that the Divisor, and on the right hand behind a crooked line made like a halfe Moone, all the severall Quotients are to be set one by another in a right line, as you may see by the figures hereafter following.

Here having made your row of Denominations and set down your Dividend, you

In.	De	′	″	‴	⁗	v	vi	vii
6	20	6	24	2	32	12	37	30
	29	31	50	7	29			

Dedomination
The Didend
The Divisor

have to consider whether the first Number of your Divisor, be greater than the first Number of your Dividend, for if it be, then you must place your Divisor one space further towards

your right hand, as in this Example, because the first Number of your Diuisor 29, cannot be taken out of 6, you set it under the second Number of the Dividend, and so all the rest of the Numbers successively towards the right hand, as the former Example shewth. Now the order of working is thus: You must first seeke out the first Number of your Diuisor, in the first Collum of the Trapezium on the left hand, which is 29, then in the row right against that 29, on the right hand, you have to seeke out those Numbers of the Dividend, which do stand right over the first Number of your Diuisor, which is 6, and 29, and if you cannot find those Numbers iustly, then seeke in the selfe-same row a Number, which is somewhat lesse and nearest in value unto it, as in this Example, because you cannot find 6, and 29, you take 6, and 17, the Quotient whereof you shall find in the foot of the Trapezium right under the said Number 6, and 17, to be 13 degrees, which you must set in the Quotient Line, and that is your first Quotient, having his proper Denomination over his head, which are degrees, and are to be found by the Rule before taught. Thus you see here that the Number of the Diuisor is to be found in the outermost Collum on the left hand, and the Number of the Dividend in that row which is right against the said Diuisor, and the Quotient in the foot of the Trapezium, right under the Number of the Dividend last found. Then you have to multiply the whole Diuisor (that is to say) every particular Number thereof by the first Quotient 13, which you may do by helpe of the Table, as you did before in the Example of Multiplication, and is to be set downe in this manner. And you shall find the whole Product to be 6.23.53.5.137.30.

29.31.50 7,30.
13

Which being set right under the first Dividend, is to be subtracted out of the same, and the remainder to be written over the head of the Dividend, as you do in common division, first then to multiply all the particular Numbers of the Diuisor by the Quotient 13, and to find every Product thereof, resort to the Table and seeke for 13 in the foot of the Trapezium, and for 30, which is the multiplicand in the outermost Collum of the Trapezium.

pezium, on the left hand, and the common angle will ſhew the Product which is 6 and 30, whereof you muſt ſet downe 30 under 30, and keeping 6 in mind, multiply againe 13 into 7, the Product whereof you ſhall finde to be 1 and 31, unto which adde the 6 which you kept in mind, and the Product ſhall be 1 and 37, where you muſt ſet down 37, and keeping 1 in mind, multiply againe 13 into 50, and you ſhall find the Product to be 10 and 50, whereunto if you adde 1 in mind, the Product ſhall be 10 and 51, whereof you muſt ſet down 51, and keeping 10 in mind, multiply 13 into 31, the Product whereof you ſhall finde in the Trapezium to be 6 and 43, whereunto if you adde the 10 which you had in mind, the Product ſhal be 6 and 53, whereof ſet down 53 and keeping 6 in mind, multiply 13 into 29 and you ſhall finde the Product to 6 and 17, whereunto if you adde the 6 in minde, the Product ſhall be 6 and 23, whereof ſet downe 23 under the laſt Number of your Multiplicand, and becauſe you have no more Numbers of the Diviſor to be multiplyed, ſet downe 6 in munde on the left hand, ſo ſhall the whole Product be 6, 23, 53, 51, 37, 30, as the former Example ſheweth, which Product is to be ſubtracted out of the firſt Dividend, and the remainder is to be ſet down over the head of that Dividend, as you ſee in this Example next following, wherein the firſt Dividend is firſt ſet downe, and right under that the foreſaid Product, which is the firſt Product, and the remaynder above the Dividend, and the Quotient 13, is ſet in the Notient line, which is your firſt Quotient.

	29	31	50	7	30				The Diviſor.
					13				The 1. Qotient.
6	23	53	51	37	30				The 1. Product.

The Remaynder.		5	12	32	25	1				
The firſt Dividend.	6	28	6	28	6	28	12	37	30	13.
The firſt Product.	6	23	53	51	37	30				

And remember (in making your Subtraction) to begin with the firſt Number of the foreſaid Product which is on the right hand, and when you cannot take it out of the Number ſtanding right ober his head, to borrow alwayes 60 of the next Number

on the left hand, and to pay it home againe with 1, for there 60 is but 1. This done, remove your Diviſor one ſpace further towards the right hand (that is to ſay) ſet the firſt Number of your Diviſor under 12, which is the ſecond Number of the ſecond Dividend, which together with the firſt remainder is 5, 12, 32, 25, 1, 12, 37, 30, and all other Numbers of the Diviſor orderly towards your right hand, as you ſee in this Example,

The ſecond Dividend.	5	12	32	25	1	12	37	30
The Diviſor.	29	31	50	7	30			

Then aſke how many times 29 is in 5 and 12, which Number you muſt ſeeke in the Trapezium in the row that anſwereth towards the right hand, to the firſt number of your Diviſor which is 29, ſtanding in the outermoſt Collum of the Trapezium on the left hand, and becauſe you cannot finde 5 and 12 in that row, you may ſeeke in the ſame row the Number which is nigheſt unto it, but leſſe, which you ſhall finde to be 4 and 50, and right under that in the foot of the Trapezium you ſhall finde 10, which muſt be your ſecond Quotient, by which Quotient you have to multiply all the particular Numbers of the Diviſor, in ſuch order as is before ſet downe, and you ſhall finde the Product of that Multiplication to be 4, 55, 18, 21, 15, 0, which Product you muſt place under the ſecond Dividend, ſetting 4 under 5, and 55 under 12, and ſo forth, orderly towards the right hand, that done, ſubtract the ſame Product out of the Numbers of the ſecond Dividend, ſtanding right ober the ſaid Product, and the remainder will be 17, 14, 3, 46, 12, as you ſee in this Example.

The remaynder.	17	14	3	46	12	37	30	
The ſecond Dividend.	5	12	32	25	1	12	37	30
The ſecond Product.	4	55	18	21	15	0		

(13. 10.

Now remove your Diviſor one ſpace further towards the right hand, by ſetting the firſt Number of your Diviſor, which is 29 under 14, which is the ſecond Number of the third Dividend, and ſo all the reſt orderly towards the right hand, as you ſee in this Example.

Then

Then aske how many times 29 is contained in 17 and 14, which

The third Dividend.	17	14	13	46	12	37	30
The Divisor.		29	31	50	7	30	

Dividend, because you cannot find it in the row that answereth to that 29 which standeth in the outermost Collum of the Trapezium, on the left hand (for all those numbers are too little) you must seeke for it in that Collum which standeth right upon 29 in the foot of the Trapezium, neither shall you find it there, but you shall find 16 and 55 which is somewhat lesser, yet in value nighest unto 17 and 14, and right against that, you shall find in the outermost Collum on the right hand 35, which must bee your third quotient, to be set in the quotient line, whereby you have againe to mutiply the whole Divisor in such order as before, the product whereof you shal finde to be 17,13,34,14,22,30, which product being placed under the Dividend, by setting 17 under 17 and 13 under 14, and so forth orderly towards the right hand, subtract the said product (beginning at the right hand) out of the numbers which stand right over the said product, and the remainder wil be 29,31,50,7,30, which is to be set downe over the third Dividend, and the rest to be cancelled, as you see in this example.

The remainder.			29	31	50	7	20	
The 3 dividend.	17	14	13	46	12	37	30	(13,10,35,
The 3 product.	17	13	14	14	22	30		

And now the remainder of the third Dividend is come to be the fourth Dividend: wherfore remove your Divisor one space further towards the right hand, by setting 29 under 29, and the rest orderly towards the right hand, as you see in the example following: then aske how many times 29 is contained in 29, which being but once, your fourth quotient is 1, and is to be set in the quotient line, whereby the whole Divisor being multiplyed, the product will be 29,31,50,7,30, which you must place under the fourth Dividend; and being subtracted out of the same, nothing will remaine, and so the whole quotient will be 13 degrees, 10′, 35″, 1‴, as you see in this example.

The fourth Dividend.	0	0	0	0	0		degr. ′ ″ ‴
The fourth Product.	2	9	32	15	8	32	(13. 10. 35. 1.

Another example of Division.

If the daily motion of the Moone be 13 degrees, 3′, 53″, 56‴, 23⁗, 58ᵛ, in what time shall she make her whole revolution, allowing 360 degrees to that revolution, which is otherwayes called the Month of Paragration. Here, for so much as this example is to be wrought by Division, and that your Dividend is a simple and whole Number (that is to say) 360 degrees, without any Fractions of divers denominations annexed thereunto: you must first set down the 360 degrees, and next to that, towards your right hand, set downe a long row of Cyphers, with so many denominations over their heads as you shall think needfull to serve your turne, and right under your Dividend set your Divisor, as you see in this example.

The Denominations.	Inte.	De.	′	″	‴	⁗	v	vi	vii	viii	ix	
The Dividend.	360	0	0	0	0	0	0	0	0	0	0	(27.
The Divisor.		13	3	53	56	23	58					
The 1 Product.		351	45	16	22	47	6					

Here you first must aske how many times 13 is in 360, and by the common Rule of Division you shall find the Quotient to be 27, which you must set downe in the Quotient line, and by that Quotient you have to multiply every particular number of the Divisor, beginning on the right hand, as you do in Multiplication, saying, that 27 times 58 is 26 and 6, as the Trapezium sheweth, for by seeking 27 in the fot of the Trapezium, and for 58 in the outermost Columne on the right hand, you shall finde in the common angle 26 and 6, wherefore set downe 6 under 58, and keeping 26 in mind, multiply 23, which is the second number of the Divisor by 27, and by the Trapezium you shall find the Product thereof to be 10 and 21, whereunto if you adde the 26 in mind, it will make 10 and 47, whereof set downe

47.

47 under 23, and keeping 10 in mind, multiply 56 which is the third number of the Diviſor by 27, and in the Trapezium you ſhall find the product to be 25 and 12, whereto if you adde the 10 in mind, it will make 25 and 22, whereof ſet downe 22 under 56, and keeping 25 in mind, multiply 53 which is the fourth number of the Diviſor by 27, the product whereof you ſhal find by the Trapezium to be 23 and 51, whereto if you adde 25 in mind, it will make 76 which is one 60 and 16, whereof ſet down 16 under 53, and adde the one in mind to 23, and that will make 24, which you muſt keepe in mind, then multiply 3 which is the firſt number of the Diviſor by 27, the product whereof you ſhal find in the Trapezium to be 1 and 21, whereto if you adde the 24 in mind, it will make 1 and 45, whereof ſet downe 45 under 3, and keeping one in mind, multiply 13 which is the laſt number of the Diviſor by 27, the product whereof you ſhall find in the Trapezium to be 5 and 51, whereunto if you adde one in mind, it will make 5 and 52, here becauſe the firſt 5 is 5 ſixties, it maketh in all 352 and is to be ſet under 360, ſo as the firſt product of this Multiplication containeth theſe numbers, 352 45, 16, 22, 47, 6, as you ſee them ſet downe in the former example, and this product is to be ſubtracted out of 360 which is the firſt Dividend. And to avoyd confuſion, it ſhall not be amiſſe to ſet downe the firſt Dividend and the firſt product apart by themſelves thus.

The 1 remainder.	7	14	43	37	12	54	0	0	0	(27,
The 1 Dividend.	360	∅	∅	∅	∅	∅	∅	∅	∅	
The 1 Product.	352	45	16	22	47	6				

Here beginning on the right hand, ſay thus: take 6 out of nothing, which will not bee, wherefore you muſt borrow 60, then by taking 6 out of 60, there will remaine 54, which you muſt ſet above that Cypher which ſtandeth right over 6, and cancell the 6, keeping ſtill the one 60 which you borrowed in mind, then ſay, 47 and one in mind maketh 48, which will not be taken out of nothing, and therefore you muſt borrow againe one 60, as you did before, ſo ſhall the remainder bee 12, which is to be ſet above the Cypher which ſtandeth right over 47, and

47, and cancell 47, and ſo proceed with like order in ſubtracting all the reſt of the numbers of the firſt Product out of the firſt Dividend, ſo ſhall the remainder be 7, 14, 43, 37, 12, 54, as you ſee them ſet down in the former figure. Now having to remove your Diviſor one ſpace further towards the right hand, you ſhal do well to make your firſt remainder, which is, 7, 14, 43, 37, 12, 54, to be your ſecond Dividend, and under that to ſet your Diviſor, as you ſee in this example.

The 2 Dividend.	7 | 14 | 43 | 37 | 12 | 54 | 0 | 0 | 0	(27. 33.
The Diviſor.	13 | 3 | 53 | 56 | 23 | 58 | 1	

Then aſke how many times 13 is contained in 7 and 14, and having found 13 in the foot of the Trapezium ſeek in that Columne for 7 and 14, and not finding it there, take in the ſelf-ſame Columne that number which is higheſt in value unto it, and leſſe, which you ſhall finde to be 7 and 9, right againſt which, in the outermoſt Columne on the right hand is 33, which muſt be your ſecond Quotient, and is to be ſet in the Quotient line next unto 27, and by this Quotient you have to multiply every number of the Diviſor as you did before, the Product whereof you ſhall finde to be 7, 11, 8, 40, 1, 10, 54, wherefore you muſt firſt ſet downe your ſecond Dividend, and then the ſecond Product right under the ſame, as you ſee in this example.

The ſecond remainder.	3 | 34 | 57 | 11 | 43 | 6 | |	(27.33.
The 2 Dividend.	7 | 14 | 43 | 37 | 12 | 54 | 0 | 0 | 0	
The 2 Product.	7 | 11 | 8 | 40 | 1 | 10 | 54 | |	

Which Product being ſubtracted out of the ſecond Dividend, the remainder will be 3, 34, 57, 11, 43, 6, which is to be ſet above the ſecond Dividend, and the Product to be cancelled, as you ſee in the former example. Here having to remove againe your common Diviſor one ſpace further towards the right hand, ſet downe firſt the laſt remainder, which now muſt be your third Dividend, and under that ſet the common Diviſor, as you ſee in this example.

The 3 Dividend.	3 | 34 | 57 | 11 | 43 | 6 | 0 | 0 | 0	(27. 33. 16.
The Diviſor.	13 | 3 | 53 | 56 | 23 | 58 | 1	

Then

Then aske how may times 13 is contained in 3 and 34, here by seeking in the fast of the Trapezium for 13, though you cannot finde in that Columne 3 and 34, yet you shall finde 3 and 28 which is the nigheſt, right against which in the outermost Columne on the left hand, you shall find 16, which must be your third Quotient, and is to be set in the Quotient line, by which Quotient you must multiply the whole Diviſor as before, the Product whereof you shall finde to be 3,29,2,23,2,23,28, which being the third Product, you must set downe under the third Dividend which was your last remainder, and to be subtracted out of the same, as you see in this example.

The third Dividend.	1	5	54	48	40	42	32	0	0
The third Product.	3	29	2	23	2	23	28		

And the remainder will be 5,54,48,40,42,32, which you must set above the third Dividend, and all the inferior Numbers are to be cancelled, as you see in the former example. Here having againe to remove your Diviſor one space further towards your right hand, the last remainder must be your fourth Dividend, under which the common Diviſor is to be set thus.

The 4 Dividend.	7	54	48	40	42	32	0	0	dayes	′	″	‴
The Diviſor.	1	3	53	56	23	58				27	33	16	26

Here asking how many times 13 is contained in 5 and 54, seeke for 13 in the fast of the Trapezium, in whose Columne you shall not finde 5 and 54, but 5 and 51, which is nigheſt unto it, and right against that, in the outermost Columne on the left hand, you shall find the Quotient to be 27, by which if you should multiply the whole Diviſor, the whole Product thereof would be 5,56,21,24,1,47,6, which is more than the Dividend, and therefore you must make your Quotient one lesse, setting downe no more but 26 in the Quotient line, by which if you multiply the Diviſor, the Product will be 5,26,41,22,25,14,8, which being subtracted out of the fourth Dividend, the remainder will be 28,7,18,17,52, which remainder if you will

you

you may make to be a firſt Dividend, and then to worke as before, if you would have your Quotient to extend to ſmaller denominations, which I leave to do, becauſe I thinke that thirds be ſmall enough. And as often as the Product of any particular Quotient ſhal be greater than the Dividend, remember to take a leſſe Quotient, even as you do in common Diviſion. But now you have to note, that though this whole Quotient here ſignifieth time, for the firſt Quotient ſignifieth dayes, the ſecond Quotient minutes of dayes, the third Quotient ſeconds, & the fourth Quotient thirds: yet for ſo much as the day is to be counted by 24 houres, and not by minutes, you muſt therefore reduce all the particular Quotients, ſaving the firſt, into houres and parts of houres, even to ſo ſmall denominations as you ſhall thinke good your ſelfe, by helpe of this Rule, which in Diviſion of Aſtronomicall Fractions, biddeth to multiply the Quotient by 2, and to divide the Product thereof by 5. As here, if you multiply the 33, which is the ſecond Quotient by 2, the Product wil be 66, which being divided by 5, the Quotient will be 13 houres, and one 60 remaining to be kept in mind: wherefore ſet downe in the place of 33', 13 houres, then multiply the third Quotient, which is 16 by 2, and that will make 32, whereunto if you adde the one 60 in mind, it will make in all 92, which being divided by 5, the Quotient will be 18, and two ſixties, which is 120 remaining to be kept in mind: wherefore inſtead of 16'' which was the third Quotient, ſet 18' of an houre, and then proceed to the fourth Quotient, which is 26''', which being multiplyed by 2 maketh 25, whereunto if you adde 120, it will make 172, which if you divide by 5, the Quotient will be 34'' of an houre, which is to bee ſet downe in the place of 26, ſo ſhall your whole former Quotient containe 27 dayes, 13 houres, 11' of an houre, and 34'' of an houre. And note, that as in the Diviſion of Aſtronomicall Fractions, to bring the Quotients to like denomination, you do multiply by 2, and divide by 5, ſo in Multiplication, to reduce the numbers of the Multiplyer, being of divers denominations, to one ſelfe denomination, you muſt by order reverſe, multiply by 5, and divide by 2, whereof I have given you an example before,

whereas

whereas I shew you how to multiply Astronomicall Fractions, according to Gemma Frisius, without the helpe of the Sexagenarie Table.

An Example shewing how to extract the square Root out of Astronomicall Fractions, by helpe of the Sexagenarie Table.

SUppose the number given to be 17,12″,33‴,4⁗, whereof you have to take the square Root, here having set downe the said numbers, with the proper Denominations over their heads, as you see in the example following, first set a prick under the last number on the right hand, and then prick every other number, leaving one void space betwixt every two pricks, as you do when you seeke the square Root of whole numbers or Integrums, as you see here in this example.

The number given, 17. 12. 33. 4.

Then resort to the Table, and seeke amongst the Products which are placed next to the line A. B. as well in the Trapezium, as in the Triangle, & see whether you can find the number standing over the first prick on the left hand, which is 17, and 12, but not finding it there, you must take that which is nighest unto it, and lesse, which you shall find in the Triangle towards B, to be 17,4, the Root whereof you shall find both in the head, and also in the outward Columne of the Triangle on the right hand to be 32, answering to the foresaid square Root, which Root you must place behind the Quotient line, then subtract 17 and 4, out of 17, and 12, and there will remaine 8, which is to be set over 12, and the 17, & 12 to be cancelled, that done, double the Root 32, which will be 64, that is to say, 1 and 4, and setting 1 under 8, and 4 under 33, aske how many times 1 is in 8, and there is 8, which is the second Quotient, by which you must multiply 1 and 4, the Product whereof will be 8, and 32, which being subtracted from the upper number, which is 8, and 33, the remainder is 1, which is to be set over 33, and the 8, and 33 to be cancelled. Finally, multiply the second Quotient 8 in it selfe, and the product will be 1, and 4, which being subtracted out of the former remainder of

the

the given Number nothing remayneth, ſo you ſhall find 32′.8″, to be the Root of the given Number, as this Example ſheweth.

Which Root if you multiply into it ſelfe ſquarely, the Product will be like unto the Number given, and by this meanes you ſhall find the given Number to be a juſt ſquare Number.

								″	‴	
								8	X	
								X	X	‴
X	X	X	X	3	3	4	.	(32′	8″.	
						X		4	4	
								1.		

But you have to note, that if the laſt Denomination ſtanding on the right hand be odde and not even, as thirds, or fifts, then you muſt ſet downe a Cypher beyond the laſt Denomination towards your right hand, and under that Cypher ſet your firſt pricke, as in this Example 3′.8″.9‴.17⁗.3′, here becauſe the laſt Denomination on the right hand is odde, that is to ſay fifts, you muſt therefore ſet downe next unto it towards thy right hand a Cypher having over his head the next Denomination which is vi, and is even, wherefore ſet your firſt pricke under that Cypher and ſo proceed towards your left hand pricking every other Number, and then worke as followeth.

								″	‴	
								13.		
								X	X	‴
X	X	X	X	2	9	.	17	8.	0	(13.
								2.	42.	

Firſt then ſeeke in the Table amongſt the ſquare Numbers nigh unto the Line A, B, for 3 and 2, which ſhould ſtand in one ſelfe ſquare Angle next unto the line A. B. for thoſe only are ſquare Numbers, and not finding it amongſt the ſquare Numbers, take that ſquare which is nigheſt unto it and leſſe, which you ſhall find to be 2, and 29, the Root whereof is 13, and to be found as well in the foot of the Trapezium right under the foreſaid ſquare Number, as alſo in the outermoſt Collum of the ſaid Trapezium on the left hand ſtanding right againſt the ſame ſquare Number, which Root is to be ſet in the Quotient line, that done, ſubtract the foreſaid ſquare Number out of the Number ſtanding right over the laſt pricke on the left hand which is 3, and 2, and the remainder will be 13, which is to be ſet over 2, and the 3, & 2 to be canceled, as you ſee in the former example, that done, double the foreſaid found Root 13, which will make 26, by which you have to divide 13, and 9, wherefore reſort to the

Tra-

Trapezium, in the foot whereof you ſhall find 26, in whoſe Collum not finding 13 and 9, take that which is nigheſt unto it and leſſe, which is 13 and 0, right againſt which you ſhall find in the outermoſt Collum on the right hand 30, which ſhould be your Quotient, but becauſe it is too great, and that the Square thereof cannot be taken out of the remaynder, you muſt make the Quotient one leſſe, and ſet in the Quotient Line no more but 29, by which 29 if you multiply 26, the Product will be 12, and 34, as the Trapezium ſheweth, which being ſubtracted out of 13, and 9 ſtanding over 16, the remaynder will be 35, which 35 is to be ſet over 9, then by multiplying the ſecond Quotient which is 29 into it ſelfe, you ſhall find by the Trapezium the Product to be 14 and 1, which being ſubtracted out 35, and 17, the remaynder will be 21 and 16, which is to be ſet over 35 and 17, as you ſee in this Example.

That done, double both the Quotients or whole Root, and the Product will be 26, 58, and having ſet 58 under 8, and 26 under 16, divide 21, 16, and 8 by 26, 58, wherefore looke for 26 in the foot of Trapezium, and for 21, 16, in that Collum, and not finding it there, take that which is nigheſt unto it and leſſe, which you ſhall find to be 21, and 14, and right againſt that in the outermoſt Collum on the right hand ſtandeth 49, which being too great to be your Quotient by 2, therefore make your Quotient no more but 47, which being ſet downe in the Quotient line, multiply thereby 26, 58, and the Product will be 21, 7, 26, which being ſubtracted out of 21, 16, and 8, the remaynder will be 8 and 42, then ſetting 42 over 8, and 8 over 16, cancell 21, 16 and 8, then multiply 47 into it ſelfe ſquarely, and you ſhall find the Product thereof in the Triangle to be 36, 49, which being ſubtracted out of 8, 42, and 0, the remainder will be 8, 6, 11, as you ſee in this Example.

21 16
13. 29.
26 The double of the 1 Quo.
14.1 The Square of the 2 Quo.

And

And thus you have found the Root of your given Number to bee 13. 29. and 47, and whether you have done right, or not you may know by multiplying the said Root into it selfe squarely, and by adding to the Product thereof the remainder, and if you would find a more exact Root, then adde more Cyphers to your given Number towards your right hand, together with their Denominations over their heads, as they increase successively, and bee sure alwayes that the Numbers of the Cyphers be even and not odde, as 2, 4, 6, and so forth, and the more Cyphers that you adde to the given Number (so as the Number of them be even) the more exact Root you shall have.



Now to give to every Number of the Root his proper Denomination, do thus, take halfe of those Denominations that are over every prick, and those shall be the Denominations of the Root, as in the former Example, whereas Seconds do stand over the last prick on the left hand, take halfe of that which is 1", wherefore the first Number of your Root must be minutes, and over the rest of the Numbers of the Root, set Seconds, Thirds, and so forth, successively untill you have brought your Root to as small Denomination as you desire.

FINIS.

A briefe

DESCRIPTION

of the Tables of three ſpeciall Right Lines belonging to a Circle, called

SINES,
TANGENTS, and
SECANTS.

Not only ſhewing why they were firſt invented, and defining the proper tearmes thereto belonging:

But alſo ſhewing divers neceſſary Uſes thereof.

Written by Maſter BLUNDEVIL.



LONDON,
Printed by RICHARD BISHOP. 1636.

THE DESCRIPTION AND VSE OF THE TABLE OF SINES.

BEcauſe there is no proportion, comparison, or likeneſſe betwixt a right line, and a crooked, the ancient Philoſophers as Ptolomy and divers other, were much troubled in ſeeking to know the meaſures of a Circle or any portion thereof by his Diameter, and by knowing the Diameter to finde out the length of any Chord in a Circle, which is alwayes leſſer than the Diameter it ſelfe, and finding that the more parts whereinto the Diameter was divided, the nearer they approached to the truth: Some of them therefore, as Ptolomy, divided the Diameter of a Circle into 120 parts, and the Semidiameter into 60 parts, and every ſuch part into 60′, and every minute into 60 ſeconds, &c. And in like manner did Arzahel, an ancient Arabian, who divided the Diameter into 300 parts, and the Semidiameter into 150′, and every of thoſe parts into 60′, and ſo forth as before, according to which computation they made their Tables: but becauſe the working by thoſe Tables was very tedious and troubleſome, by reaſon that it was needfull continually to uſe the Art of numbring by Aſtronomicall Fractions: therefore Georgius Purbachius, and Regio Montanus his Scholler, to avoyd that trouble of calculating by Aſtronomicall Fractions, divided the Diameter of a Circle into a farre greater number of parts, and made ſuch Tables as are uſed at this preſent, the deſcription and uſe whereof doth hereafter follow, firſt of thoſe that are ſet downe by Monte Regio in Folio, and then of thoſe

that were lately corrected and made perfect by Clavius the Iesuite which are printed in Quarto.

And because that the way to finde out the proportion which any Chord hath to the whole Diameter, was very hard, therefore the said Purbachius and Monte Regio, having direction from certaine propositions of Euclid, as from the 47 proposition of his first Booke, and from the third propositien of his third Booke, and from the 15 propositiou of his fift Bwk, they made choyce of the halfe Chord and Semidiameter of the Circle, calling the halfe Chord, Sinum rectum, and the Semidiameter Sinum totum. And because that the proportion of any Circumference to his Diameter never changeth, how great or how little soever the Circle be: after that they had calculated for one Circle, they made such Tables as might serve for all Circles, and though these Tables of Sines do suffice to worke thereby all manner of conclusions, as well of Astronomy, as of Geometry, yet for more ease, our moderne Geometricians have of late invented two other right lines belonging to a Circle, called lines Tangent, and lines Secant, and have made like Tables for them that were made for Sines, and both Tables, that is to say, as well of the Sines, as of the lines Tangent and Secant, have one selfe manner of working thereby, as shall plainly appeare hereafter when we come to describe the same. But first wee will beginne with the Tables of Sines, and plainly define every terme or vocable of Art, belonging thereunto: The termes are these here following: An Arch, a Chord, Sinus rectus, Sinus versus, Quadrans, Complementum, and sinus Complementi.

The definitions of the foresaid termes.

AN Arch, is any part or portion of the Circumference of a Circle, which in this practice doth not commonly extend beyond 180 degrées, which is one halfe of the Circumference of any Circle, how great or small soever it be, for every Circle containeth 360 degrées.

A Chord is a right line drawne from one end of the Arch to

to the other end thereof, and note that all Chords are alwayes lesser than the Diameter it selfe, for that is the greatest Chord in any Circle.

Sinus rectus, is the one halfe of a Chord or string of any Arke, which is double to the Arke that is given or supposed, and falleth with right angles upon that Semidiameter which divideth the double Arke into two equall parts,

Sinus versus, that is to say, turned the contrary way, is a right line, and that part of the Semidiameter which is intercepted betwixt the beginning of the given Arke and the right Sine of the same Arke, and this is also called in Latine Sagitta, in English a Shaft or Arrow, for the Demonstrative figure thereof hereafter following, is not unlike to the string of a bow ready bent, having a Shaft in the middest thereof.

Quadrans, is the fourth part of a Circle containing 90 degrees.

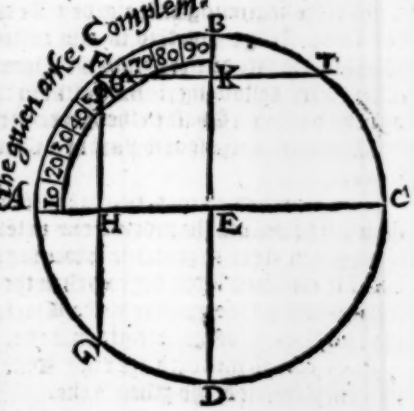
Complementum arcus, is that portion of the Circle, which sheweth how much the given Arke is lesser than the quadrant: if the given Arke do containe fewer degrees than the quadrant, but if it containe more degrees than the quadrant, then the difference betwixt the quarter of the Circle and the said Arch, is the complement of the said given Arke.

Sinus complementi, is the right Sine of that Arch which is the complement of the given Arke.

Sinus totus, is the Semidiameter of the Circle, and is the greatest Sine that may be in the quadrant of a Circle, which according to the first Tables of Monte Regio containeth 6|000|000, & according to the last Tables, 10|000|000 parts, for the more parts that the totall Sine hath, the more true and exact shall your worke be; notwithstanding, sometime it shall suffice to attribute unto the totall Sine, but 60|000 parts, which numbers Appian observeth, in teaching the way to finde out the distance of two places, differing both in longitude and latitude, by the Tables of Sines, and some do make the totall Sine to containe 100|000 parts, as Wittikindus in his Treatise of Dials, and divers ether do the like. Also Clavius saith, That in the Tables set downe by him in Quarto, you may

sometime make the totall Sine to be but 100000, so as you cut off the two last figures on the right hand in every Sine, but you shall better understand every thing here above mentioned, by the figure demonstrative here following.

The Figure Demonstrative.



In this figure you see first a whole Circle drawne upon the Center E, and marked with the lettters A, B, C, D, which Circle by two crosse Diameters, marked with the letters A C, and B D, and passing both thorow the Center E, is divided into foure Quadrants or Quarters, the upper Quadrant whereof, on the left hand is marked with the letters A, B, E, in which Quadrant the right perpendicular line marked with the letters F, H, betokeneth the right Sine of the given Arke A F, which right Sine is the one halfe of the Chord or string F G, and the given Arke A F, is the one halfe of the double Arke or Bow G A F, and A H is the Shaft, called in Latine Sinus versus: Againe, the letters F B do shew the complement, which together with the given Arke A F, do make the whole Quadrant A F B, which is divided into 9 spaces, every space containing 10 degrees, whereby you may plainly perceive, that in this demonstration, the given Arke A F, is 50 degrees, and the complement F B, is 40 degrees, both which being added together, do make up the whole Quadrant

of

of 90 degrées, marked with the letters A F B. Now Sinus complementi is the croſſe line, marked with the letters F K, the total Sine, which is the whole Semidiameter, and greateſt right Sine, is marked with the letters B E. But becauſe it is not enough to know the ſignification of the things above ſpecified, to uſe the foreſaid Tables when nede is, unleſſe you know alſo how to finde out thoſe things in the ſaid Tables, I thinke it good therefore to ſhew you the order of the ſaid Tables, by deſcribing the ſame as followeth.

You have then to underſtand, that the Tables of Monte Regio, printed in Folio, are contained in 18 pages, and every page containeth 11 partitions, called Columnes, whereof the firſt on the left hand containeth 60', which are to be counted from head to foot, as they ſtand in order one right under another in ſeverall places, proceeding from 1 to 60. The ſecond Columne containeth Sines. The third containeth only a portion or part of one ſecond, and from thence forth proceeding toward the right hand, al the other Columnes do containe in like manner Sines, and the proportion of one ſecond. And right ober the head of every Sine (the firſt Columne of Sines only excepted, having nothing but a Cypher over his head) are ſet downe the degrées of the whole Quadrant, called Arches, in ſuch order as from the firſt page to the laſt, there are in all 89 degrées or Arches, as by peruſing the ſaid Tables, you may plainly ſee. Now to finde out in theſe Tables the things above mentioned, you muſt do as followeth.

Firſt, to find out the right Sine of any given Arke, you muſt ſeek out the number of the ſaid Arke in the Front of the Tables, and if the given Arke hath no minutes joyned thereunto, then the firſt number of Sines right under the ſaid Ark, is the right Sine thereof. But if it hath any minutes joyned thereunto, then you muſt ſeeke it out in that page where you found the given Arke, the number of the minutes in the firſt Columne of the ſaid page on the left hand, and right againſt thoſe minutes on the right hand, in the ſquare angle right under the ſaid Arch, you ſhall finde the right Sine. As for example, you would finde out the right Sine of a given Arke containing 8 degrées

and 20′, here having found out in the Front of the second page the figure of 8 standing right over the eighth Columne, seeke in the first Columne on the left hand of the said page, for 20′, and right against the 20′, you shall finde on the right hand, in the common angle or square, 869593, which is the right Sine of the foresaid given Arke, so as you make 600000 to be the totall Sine: but if you make 60000, the totall Sine, then you must alwayes reject the two last figures, standing on the right hand of the said right Sine, and the rest of the figures shall be the right Sine.

Now to find out the complement, there is nothing to be done, but only to subtract the given Arch out of the whole quadrant, which is 90 degrees, and the remainder shalbe the complement: as in the former example, by subtracting 8 degrees 20′ out of 90 degrees, you shall finde that there remaineth 81 degrees, 40′, which is the complement of that Arch. Againe, to finde out the Sine of the complement, you must do thus: seeke the complement in the Front of the Table of Sines, even as you do to find out any given Arch: as in the former example, the complement being 81 degrees, 40′, you must seeke 81 in the Front of the 17 page of the first Tables, which being found, seeke out also the 40′ in the first Columne of the said page on the left hand, and right against those 40′ in the common angle right under the Arch 81, you shall finde 5936649, which number is the right Sine of the foresaid complement, so as you make 6000000, to be the totall Sine, for if 60000 be the totall Sine, then you must reject (as I said before) the two last figures on the right hand, and the number remaining shall be the right Sine of the foresaid complement, and therefore in working by these Tables, you must alwayes remember what number you make the totall Sine to be.

Sinus versus commeth seldome in use, notwithstanding if you would know how to finde it out, you need do no more but to subtract Sinum complementi of the given Arch, out of the totall Sine, and the remainder shall be Sinus versus, as in the former example, your Sinus complementi was 5936649, which being subtracted out of the totall Line 6000000, there remaineth

remayneth 63|351, and that number is Sinus versus: for if you adde this remaynder to the number which you subtracted, it will make up the totall Sine 6|000|000. But there is one thing more necessary to be knowne than this, because it commeth oftner in use, and that is upon some division made, how to finde out the Arch of any Quotient, which is to be done thus: Enter with the Quotient into the body of the Tables and leave not seeking amongst the squares of the Sines, untill you have found out the just number of the Quotient (if it be there) if not, you must take the number of that Sine which is in value most nigh unto it, whether it be a little more or lesse, it maketh no matter, and having found that number, looke in the Front of that Columne, and you shall finde the Arch of your Quotient standing right over the head of that Columne, and also the minutes thereof in the first Columne of the said page on the left hand. As for example, having divided one number by another, I finde the Quotient to bee 469|012, whereof I would know the Arch: now in seeking this Quotient among the Sines I cannot finde that just number, but I finde in the first page, and in the tenth Columne 469|015, which is the nighest number unto it, that I can see. In the Front of which Column, I find the Arch to be 4 degrees, and directly against that Sine on the left hand, I finde 29' belonging to that Arch, whereof the Quotient is the Sinus, so as I gather hereof, that the Arch of the foresaid Quotient is 4 degrees, 29'. But you have to note by the way, that the number of your Quotient must never be much lesse than 1745. for otherwise it is not to be found in these Tables, unlesse you make the totall Sine to be but 60|000, for then by rejecting the last two figures on the right hand, as I have said before, the first right Sine of these Tables shall be no more but 17, and by that account a very small Quotient may be found in these Tables: and whatsoever hath beene said here touching the order that is to be observed in the first Tables of Monte regio, whose totall Sine is 6|000|000, the like in all points is to be observed in the last Tables, whose totall Sine is 10|000|000. Thus much touching the order of the foresaid Tables of Monte Regio, printed in Folio. But forasmuch as those Tables be not altogether truly

printed,

printed, and for that they have bin lately corrected, and made more perfect by Clavius, who doth set downe the said Tables in Quarto, and not in Folio, wherbythey are the more portable, & the more commodious, as well for that are more truly printed, as also for that the complement of every Arch is set downe in every page at the foot of every Columne, so as you need to spend no time in subtracting the Arch from 90, I thinke it good therefore to make a briefe description of those Tables, and the rather for that I have requested the Printer to print the like here in Quarto, and I do worke all such conclusions as hereafter follow by the said Tables, the totall Sine wherof is 10|000|000 according to the last Tables of Monte Regio. But for so much as some may have already the Tables of Monte Regio, printed in Folio, not knowing perhaps the use thereof, I will set downe two conclusions to be wrought by those Tables, and all the rest of the conclusions are to be wrought by those Tables which I have here caused to be printed in Quarto, like to those of Clavius: though the two conclusions next following, which are to shew the use of the foresaid Tables, may be wrought by the Tables of Sines, in what forme soever they be truly printed, in Folio or in Quarto, yet because I had appointed them to be done by the Tables of Monte Regio, printed in Folio, before that ever I saw Clavius his booke, I mind not now to alter them, but to let them stand still as they are.

How to find out by the said Tables, the distance betwixt two places, differing both in longitude and latitude, making the totall Sine to be no more but 6o|000.

THis is done by finding out two numbers, whereof the one is called in Latin Primum inventum, that is to say, the first found number, and the other is called, Secundum inventum, that is, the second found number, in such order as followeth.

First, then knowing the longitude of eyther place, take the difference of their longitudes, by subtracting the lesser longitude out of the greater: that done, multiply the right Sine of that difference into the Sine of the complement of the lesser lati-

latitude, and divide the Product of that Multiplication by the totall Sine, and then seeke out the Arch of that Quotient, according to the Rule before taught, so shall you have the first found number: That done, multiply the right Sine of the lesser latitude by the totall Sine, and having divided the Product thereof by the right Sine of the complement of the first found number: subtract the Arch of that Quotient out of the greater latitude, and you shall have the second found number: Then multiply the right Sine of the complement of the first found number into the right Sine of the complement of the second found number, and having divided the Product of that Multiplication by the totall Sine, seek the Arke of the Quotient in the Tables, and take that Arke out of the whole quadrant, and the degrees that do remaine, are degrees of the great Circle, which if you multiply by 60, the Product of the Multiplication will shew you how many Italian miles the one place is distant from the other, or if you would have Germane miles, then multiply the foresaid degrees of the great Circle by 15, or else divide the Product of the Italian miles by 4, and you shall have your desire. As for example, you would know what distance is betwixt Hierusalem and Noremberg, a famous Towne in Germany: Hierusalem according to Appian his Tables, hath in longitude 66 degrees, 0′, and in latitude 31 degrees, 40′. Againe, Noremberg hath in longitude 28 degrees, 20′, & in latitude 49 degrees, 24′, the difference of their longitudes is 37 degrees, 40′, the right Sine whereof is 36|664, for in this example Appian maketh 60|000 to be the totall Sine, and therefore he reiecteth the two last figures on the right hand, found in the first Tables of Monte Regio. Now you must multiply 36|664 into the right Sine of the complement of the lesser latitude, which Sine is 51|067, the Product of which two Sines being multiplyed the one by the other, amounteth to 1|872|320|488, which if you divide by the totall Sine 60|000, you shall finde in the Quotient 31|205, whose Arch is 31 degrees, 20′, and this shall be your first found number. This done, multiply the right Sine of the lesser latitude, which is 31|498, by the totall Sine 60|000, and the Product thereof will be 1|889|880|000, which summe

if

if you divide by the Sine of the complement of the firſt found number, which Sine is 51249, you ſhall finde in the Quotient 36876, the Arke whereof is 37 degrees, 55′, which Arch being ſubtracted out of the greater latitude, there will remayne 11 degrees, 29′, and that ſhall be your ſecond found number, then multiply the foreſaid Sine of the complement of the firſt found number, which is 51249, by the Sine of the complement of the ſecond found number, which is 58798, and the Product thereof will amount to 3013338702, which if you divide by the totall Sine, you ſhall finde in the Quotient 50122, the Arch whereof is 56 degrees, 50′, which being ſubtracted out of the whole Quadrant, which is 90 degrees, there will remaine 33 degrees, 10′, of the greater Circle, which 33 degrees, if you multiply by 60, it will make 1980 miles, whereunto you muſt adde for the 10′, 10 miles, ſo ſhall you finde the diſtance betwixt the two foreſaid places, to bee 1990 Italian miles, which if you would reduce into Germane miles, then divide that number by 4, for foure Italian miles do make but one Germane mile, ſo ſhall you have 497 Germane miles, and two Italian miles remayning, which is halfe a Germane mile: Which ſumme agreeth with that which Appian ſetteth downe in his Geography, whereas he uſeth the ſelf-ſame example, and worketh it in like manner, Per Tabulas Sinuum.

The altitude of the Sunne being knowne, how to finde out the longitude of the ſhadow both right and verſe of any body yeelding ſhadow, by helpe of the foreſaid Tables.

FIrſt, you have to underſtand, that every bodily thing yéelding ſhadow, is divided into 12 equall parts, and every ſuch part into 60 minutes, and every minute into 60 ſeconds, and ſo forth. Againe, of ſhadowes there be two kinds, that is, Vmbra recta, and Vmbra verſa: Vmbra recta, is that which proceedeth from ſome body rightly erected upon the upper face of the Horizon, as from ſome Tower or poſt ſtanding right up uppon a levell ground: and that ſhadow is called Vmbra verſa, which proceedeth from ſome right ſtile or pearch, being

thruſt

thruſt into a wall or poſt, ſtanding right up, and not leaning, in ſuch ſort, as the ſaid ſtile or pearch may be a juſt Parallel to the upper face of the Horizon. Now to finde out the length of either of the foreſaid ſhadowes, you muſt do thus:

Multiply the right Sine of the complement of the given Solar altitude by 12, and divide the Product by the right Sine of the ſaid Solar altitude, and you ſhall have the longitude of the right ſhadow of the ſaid body. Againe, if you multiply the right Sine of the foreſaid altitude by 12, and divide the Product by the Sine of the complement of the ſaid altitude, you ſhall have the longitude of Vmbra verſa of the ſaid body. As for example, ſuppoſe the given Solar altitude to be 25 degrees, the complement whereof is 65, and the right Sine of that complement is 54|378, if you make the totall Sine to be 60|000. Then in multiplying the foreſaid right Sine by 12, the Product will be 652|536, which if you divide by the Sine of the altitude, which is 25|357, you ſhall finde the longitude of Vmbra recta to be 25 parts, 44′, 42″, and 6‴. Now if you multiply the Sine of the altitude, which is 25|357 by 12, and divide the Product by the Sine of the complement, which is 54|378, you ſhall finde the longitude of Vmbra verſa to be 5 parts, 35′, and in ſaying here parts, I meane alwayes ſuch parts, as are the twelve parts, whereinto the body yelding ſhadow, is divided: But if you worke this example by the firſt Tables of Sines, making the totall Sine 6|000|000, though you finde it true in the parts and minutes, yet ſhall you not finde it ſo in the ſeconds and thirds, and if you worke the ſame by the ſecond Tables, making the totall Sine 10|000|000, you ſhall finde it to agree only in the parts, but neither in minutes nor ſeconds, which maketh me to ſuſpect, that the Printer hath committed ſome error therein, for both the Tables were made by one ſelfe Rule.

A briefe

A briefe description of the Tables of Sines *printed in Quarto, like unto those which* Clavius *setteth downe in his Commentaries upon* Theodosius *his Spheriques.*

HAving here before plainly described unto you the Tables of Sines made by Monte Regio, which are printed in Folio, and how to use the same: I will now briefly describe the said Tables lately corrected by Clavius, and were printed in Quarto at Rome, Anno 1586, the totall Sine of which Tables, according to the last Table of Monte Regio, is 10|000|000, by which Tables are to be wrought all the conclusions hereafter following.

First, then you have to understand, that these Tables are contained in 36 pages, in the front whereof are set down the degrees of the quadrant, proceeding from 1 to 89, but because the whole number of minutes belonging to the said degree, which is 60′, cannot be all placed in one selfe page, but only 30′ in the left outermost Columne of the left hand page: & other 30′ in the left outermost Columne of the right hand page: therfore the degrees or arches of the quadrant are faine to be twice repeated in the front of every two pages, as you may plainly see by viewing the said Tables, and every page containeth seven Columnes, whereof the first on the left hand containeth the minutes belonging to the degrees or arches of the quadrant, which minutes do proceed downward from 1 to 30′, and the seventh Columne on the right hand in every page, containeth the minutes belonging to the complement of every arch, which minutes do proceed backward that is to say, from 1 set downe at the lowest end of the last Column of the second page, and so proceeding upward to 30′, which 30′ is also set down at the lowest end of the last Columne of the left hand page, & so proceedeth upward to 60′, which 60′ do helpe to make up the complement that is answerable to every arch whereunto no minutes be annexed, for if that arch hath no minutes, then you must adde to the complement thereof 60′ which is one whole degree to make up the complement. As for example, suppose the Ark to be 46 degr. without any minutes joyned

thereunto

thereunto, the complement whereof ſet downe at the foot of the ſaid arch, is but 43 degrees, wherefore you muſt adde thereunto 60′ which is one degree, ſo ſhall the complement be 44 degrees, which is the true complement indeed, but if you ſuppoſe the foreſaid Arke to have 13′ joyned thereunto, you ſhall finde the complement to be 43 degrees, 47′, which is anſwerable to the foreſaid arch, 46 degrees, and 13′, for if you take 46 degrees, 13′ out of 90 degrees, the remainder will be 43 degrees, 47′, which is the complement, ſo as you neede not to make any ſubtraction out of 90, to finde the complement of any arch, that hath any minutes annexed thereunto: but whenſoever you have to finde out the right Sine of any complement in theſe Tables, you muſt then make the complement an arch, ſeeking for the ſame in the Front and not at the foot of the Tables, and if the ſaid complement have any minutes annexed thereunto: you muſt ſeeke thoſe minutes in the left outermoſt Columne of every page, and not in the outermoſt right Column belonging to complements, for in this caſe the complement is an arch and not a complement. The order of working by theſe Tables in all other things differeth not one jot from that which we have obſerved in working the two former concluſions by the Tables of Monte Regio printed in Folio, as you ſhall eaſily perceive by the Examples here following.

1 *How to finde out the declination of the Sunne at any time, his place in the Zodiaque being given,* Per Tabulas Sinuum.

KNowing the place of the Sunne for the day, conſider how much the ſaid place is diſtant from the firſt point of Aries, if the place of the Sunne be nigher to Aries than to Libra. But if it bee nigher to Libra, then take his diſtance from the firſt point of Libra, which diſtance muſt not exceed 90 degrees, and ſeeke that diſtance amongſt the arches in the Front of the Tables if they be degrees, if minutes, you ſhall finde them in the firſt Column on the left hand, then multiply the Sine of that diſtance by the Sine of the greateſt declination which is 23 degrees, 28′, and divide the Product thereof by the totall Sine, and

the

the Quotient will shew you the Sine of the declination for that day, the Arch whereof is the very Number of the declination it selfe. As for example, you would know the declination of the Sunne the eleventh of Aprill 1591, when as the Sunne was entred 33′ into Taurus, unto which you must adde according to the Rule before given 30 degrees, for that is his distance from the first point of Aries, then seeke out the said 30 degrees, in the Front of the last Tables among the Arches, and the 33′ in the first Column on the left hand, right against which you shall finde the Sine of the said distance to be 5082|901, which being multiplyed by 3|982|155, (which is the Sine of the greatest declination) the Product thereof will bee 20|240 890|631|655, which if you divide by the totall Sine which is 10|000|000, you shall finde the Quotient to be 2|024|089, which Quotient must be sought out in the said Tables, and if you find no such Number, then take the nearest Number thereunto, which is 2025025, and the Arch thereof together with the minutes that stand right against the said Quotient in the first Columne on the left hand, is the declination of the Sunne for that day, which is 11 degrees, 41′.

2 *How to know the right ascension of the Sunne* Per Tabulas Sinuum.

FIrst, knowing the Sunnes place, you shall learne the right ascention thereof thus: First, consider how farre his place is from the Equinoctiall point, as is said before in the last proposition, and multiply the Sine of the complement of that distance by the totall Sine, then knowing the declination of the Sunne for that day, by the last Rule, divide the former Product by the Sine of the complement of the said declination, and the Quotient will shew the Sine of that Arch, whereof the complement is the right ascension. As for example, the Sunne being in the 33′ of Taurus, and his declination 11 degrees, 41′, as you found by the last proposition, and his distance from the first point of Aries, to be in all 30 degrees, 33′, the complement whereof is 59 degrees, 27′. the Sine of which complement is 8|611|860, which being multiplyed by the totall Sine, which

is

is 10|000|000, the Product will be 86|118|600|000|000, which being divided by the Sine of the complement of the Sunnes declination, which is 78 degrees, 19', whose Sine is 9792818, by which Sine if you divide the former Product, the Quotient will be 8|794|057, the Arch of the Quotient is 61 degrees, and 34', and the complement of that is 28 degrees, and 26', which is the right ascention of the place of the Sunne for the foresaid day.

And here note, that if the Arch from Aries to the given point, do containe just 90 degrees, the right ascention thereof is also 90 degrees, but if the said Arch be more than 90 degrees, and lesser than 180 degrees, then subtract the same out of 180, and seeke out the right ascention of the remaynder as before, whose right ascention if you take out of 180, the remaynder shall be the ascention of the propounded Arch. But if the said Arch which is comprehended betwixt Aries and the given point, be greater than 180 degrees, or 6 Signes, and lesser than 270 degrees, or 9 Signes, then having subtracted 180 degrees from the same Arch, calculate the right ascention of the Arch from the beginning of Libra, as before, and the right ascention thereof being added to 180 degrees shall be the ascention desired.

Lastly, if the Arch comprehended betwixt Aries and the point given, be greater than 270 degrees, or 9 Signes, then subtract the same out of 360 degrees, and seeke out the right ascention of that remaynder as before, which if you subtract out of 360 degrees, the remaynder shall be the right ascention desired.

3 *How to finde out the ascentionall difference* Per Tabulas Sinuum.

Multiply the Sine of the latitude given by the totall Sine, and divide the Product by the complement of the said latitude, that done, multiply the Quotient by the Sine of the Sunns declination, & divide the Product by the Sine of the complement of the declination, and the Quotient thereof will shew the Sine of the ascentionall difference: and by working according to this

Rule, you ſhall finde that when the Sun is entred 33′ into Taurus, at which time his declination is 11 degrees, 41′, (as hath been ſaid before) the aſcentionall difference will be 15 degrees, 21′. And here note, that aſcentionall differences for one quarter of the Circle ſerveth alſo for all the reſt, ſo that the latitude be not altered, and that the declination of the points in the later quarters, be equall to the declination of the points in the firſt quarter.

4 *How to finde out the oblique aſcention of any point of the Ecliptique in any latitude aſſigned.*

FIrſt, finde the right aſcention of the given point by the ſecond Propoſition, and alſo the aſcentionall difference thereof by the third Propoſition: then conſider whether the declination of the ſaid point be Northward or Southward, for if it bee Northward, then ſubtract the aſcentionall difference out of the right aſcention, and the remaynder ſhall be the oblique aſcention deſired: but if the declination be Southward, then adde the aſcentionall difference unto the right aſcention, and the ſum ſhall be the oblique aſcention. In working thus for the latitude 52, and ſuppoſe the Sun to be in the 33′ of Taurus, and having found by the former Propoſition his right aſcention to be 28 degrees, 41′, and the aſcentionall difference to be 15 degrees 21′, you ſhall finde his oblique aſcention in the foreſaid latitude to be 13 degrees, 20′.

5 *How to finde out the time of the Suns riſing and ſetting, and thereby the length of the artificiall day.*

FIrſt, you muſt know the aſcentionall difference, and convert the ſame into houres and minutes, then if the Sun be in any of the Northerne Signes, adde thoſe houres to 6 houres, which is the one halfe of an Equinoctiall day, and the ſumme of ſuch Addition ſhall be the one halfe of the artificiall day, which being ſubtracted out of 12 houres, the remaynder ſhall be the houre of the Sunnes riſing: As for example, the Sunne being in the 33′

of

of Taurus, you found the aſcentional difference to be 15 degrées, and 21′, which being turned into houres, maketh one houre, 1′, 2″, and ſomwhat more, which being added to 6, maketh 7 houres, 1′, 2″, and a little more, which is the one halfe of the artificiall day, which being doubled, maketh in all 14 houres, 2′, and 4″, but if the Sunne be in any of the Southerne Signes, you muſt remember to ſubtract the houres of the aſcentionall difference out of 6 houres, and the remaynder ſhall be the one halfe of the artificiall day, and by ſubtracting the halfe length of the artificiall day out of 12, you ſhall know the houre of the Sunnes riſing, and having the time of his riſing, you muſt needs know the time of his ſetting.

6 *How to finde out the Meridian altitude of the Sunne in any day, though he doth not ſhine at all, the elevation of the Pole being given.*

Subtract the elevation of the Pole from 90, and the remaynder ſhall be the elevation of the Equinoctiall; then if the Sun be in any of the Northerne Signes, adde the declination of the Sunne unto the altitude of the Equinoctiall, or elſe if he be in any of the Southerne Signes, ſubtract the declination, and the ſumme of the addition, or remaynder of the ſubtraction, ſhall ſhew the Meridian altitude. As for example, the ſecond of May 1591, the Sunne being in the 20 degrée, 41′ of Taurus, and his declination Northward 17 degrées, 56′, 21″, here by ſubtracting 52 degrées, which is our latitude, from 90, you ſhall finde the remaynder to be 38, which is the altitude of the Equinoctiall, whereunto if you adde the Suns declination for that day, which is 17 degrées, 56′, and 21″, the ſumme will be 55 degrées, 56′, and 21″, and that is the Meridian altitude of the Sunne for that day.

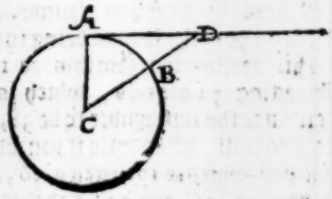
Let theſe few concluſions ſerve to ſhew you the uſe of the Tables of Sines, for it would make a long Booke to ſet downe ſo many concluſions as are to be wrought by theſe Tables, and therefore I leave to trouble you any further therewith, minding now briefly to declare unto you the uſe of the Tables

of lines Tangent and Secant by one example or two as followeth. But first I thinke it necessary to shew you what those lines be, and whereto they serve.

The description and Use of the Tables of *Tangents* and *Secants*.

EVclid in the second Proposition of his third Booke defineth the line Tangent in this sort. A right line (saith he) is said to touch a Circle, when it toucheth it so, as being drawne out in length, it would never cut the said Circle.

The line Secant is not by him any where defineth, but what these two lines are, you shall better understand by this figure Demonstrative here following, than by any definition that can be made thereof: for a definition ought to be plain and briefe, and not long, intricate, or doubtfull, which will be hardly performed in shewing the nature of these two lines by way of definition, and therefore marke well this figure following.



In this figure you see first a Circle drawne upon the Center C, from which Center is extended to the Circumference of the Circle, a right line called the Semidiameter, marked with the letters A C, then there is another right line which toucheth the said Circle, and also the outermost end of the said Semidiameter, making therewith a right angle in the point A, and is called the line Tangent, then there is a third line which proceeding from the Center C, doth cut the Circumference of the Circle in the point B, and also meeteth with the line Tangent in the point D, and therefore is called the line Secant, betwixt

twixt which two lines I meane the Tangent and Secant, is intercepted or included a certaine portion or Arch of the forefaid Circle, leſſe than a quadrant, marked with the letters A B, of which Arch the line A D is the Tangent, and the line C D is the Secant thereof, which muſt needs meet with the Tangent in the point D, becauſe that the two angles C A D, and D C A, are leſſer than the two right angles, for the one is right, and the other ſharpe, by reaſon that the Arke is leſſe than a quadrant. And ſome do call the line Tangent, the line Aſcript, becauſe it is aſcribed to the Circle, and they cal the line Secant the Hipothenuſe, becauſe it ſubtendeth the right angle A, and they call the Semidiameter or totall Sine, the Baſe of the Rectangle Triangle C A D, which is called a Rectangle Triangle, becauſe it containeth one right angle marked with the letter A, and note that whenſoever any manner of angle is propounded by three letters, that the middle letter doth alwayes ſignifie the angle propounded, bee it right, ſharpe, or blunt. Now, if you would know to what end the forefaid two lines were invented, and whereto they ſerve, you have to underſtand, that they chiefly ſerve in calculating the quantity of angles and their ſides, as well in right lined Triangles as in Sphericall Triangles, for the ſides of Triangles are eyther right or crooked, and if they have right ſides, ſuch Triangles are eyther right angled Triangles, or oblique angled Triangles. And you have to note, that the quantity of every angle is to be meaſured by the Arch of a Circle ſubtending that angle, for the point of every angle is imagined to bee the Center of a whole Circle, which you may ſuppoſe to be ſo great or little as you will, for every Circle (bee it great or little) is divided into 360 degrees, and looke how many degrees and minutes the Arch ſubtending that angle containeth, ſo much is the quantity of that angle, the practice whereof is very well ſet down by Clavius in his Commentaries upon Theodoſius, which I mind (God willing) hereafter to tranſlate in our mother tongue: In the mean time my intention here, is only to ſhew you by one example or two, the uſe of the Tables made for the forefaid line Tangent and Secant.

The use of the said Tables according to Clavius *is thus.*

IN seeking out the Tangent or Secant of any Arke given, or of the complement of any Arke by eyther of these Tables, you have to observe the selfe-same order which you did before in finding out the right Sine of any Arke given, or of the complement of any Arke, Per tabulas Sinuum. As for example, if you would finde out the Tangent of an Arke containing 50 degrees, 24′ then resort to the Table of Tangents; in the Front whereof, looke first for the Arke 50 degrees, and then in the first Columne on the left hand of the said Table, for 24′, right against which on the right hand under the Arke 50, you shal finde in the common angle the Tangent to be 12087923, the totall Sine whereof is 10000000, but if you would finde out the Secant of the foresaid Arke 50, and 24′, then you must resort to the Table of Secants, and having found out the Arke 50, in the Front of the said Tables, and the 24′ on the left hand as before, you shall finde in the common angle, the Secant to be 15688144. And if you would have the Tangent of the complement of the said Arke, which is 39 degrees, and 36′, you shall finde the 39 degrees of the complement in the foot of the Table of Tangents right under the Arke 50, and the 36′ in the outermost Columne on the right hand of the said Table, with which complement you must enter the Table of Tangents, seeking for 39 degrees in the Front of the Table, and 36 in the first Column on the left hand of the said Table, right against which in the common angle, you shall finde 8272720, to the Tangent of 39 degrees, 37′, which is the complement of 50 degrees, 24′.

And you must worke in like manner with the Table of Secants: As for example, if you would finde the Secant of 72 degrees, 36′, first then enter the Table of Secants looking for 72 degrees above in the Front of the Table, and 36 in the first Columne on the left hand of the said Table, and in the common angle you shall finde 33440249, which is the Secant of 72 degrees, 36′. But if you would have the Secant of the complement of the said Arch, 72 degrees, 36′, then looking in the foot

of

of the Table right under 72 degrees, you shall finde 17 degrees, and in the outermost Columne on the right hand, just against 36′, you shall finde 24, so as you see that 17 degrees 24′, is the complement of 72 degrees, 36′, with which complement you must enter the Table of Secants, loking for 17 degrees, above in the Front of the Table, and for 24′ in the first Column on the left hand of the said Table, and in the common angle you shall finde 10|479|541, to be the Secant of the Arch, 17 degrees, 24′, which is the complement of the Arch, 72 degr. 36′.

The use of which Tables in *Astronomicall* matters, I have here set downe, as followeth.

1 *To finde out the declination of the Sunne, the place thereof being known.*

Multiply the Secant of the complement of the greatest declination by the totall Sine, and divide the Product by the Sine of the Sunnes distance from one of the Equinoctiall points, the Quotient is the Secant of an Arch, whose complement is the declination of the Sunne: For example, suppose that the Sunne be entring into ♉, to finde the declination thereof, first I multiply 25112030, the Secant of 66 deg. 32′, (which is the complement of 23, deg. 28′, the greatest declination) by 10000000, the Product is 251120300000000 which being divided by 5000000, (the Sine of 30 degrees the Sunnes distance from the Equinoctiall point) the Quotient is 50224060, for which number I seeke in the Table of Secants, the Arch answering nerest unto it, is 78 degrees, 31′, the complement whereof is 11 degrees, 29′, which is the declination of the Sunne.

2 *Knowing the declination of the Sunne, how to finde his distance from the Equinoctiall point, and so consequently his place in the Zodiaque.*

MUltiply the Secant of the complement of the greatest declination by the totall Sine, and divide the Product by the Secant of the complement of the declination given, the Quotient is the distance of the Sun from the Equinoctiall point. As for example, the declination of the Sun is supposed to be 11 degrees, 29′, then to finde distance from the Equinoctiall, I multiply 25112030, the Secant of 66 degrees, 32′, which is the complement of the greatest declination (by the totall Sine the Products is 25112030000000,) which I divide by 50224350, the Secant of 78 degrees, 31′, the complement of 11 degrees, 29′, the supposed declination, the Quotient is 5000000, the Sine whereof is 30 degrees 0′, which is the distance of the Sunne from the Equinoctiall: then for his place, you must take the same according to the season of the yeare, for if it be in April, then the Sun is entring into Taurus, but if it be in August, it is entring into Virgo, and being in October, it is entring into Scorpio, and being in February, it is in the beginning of Pisces.

3 *To finde out the right ascention of the Sunne.*

MUltiply the Tangent of the distance of the Sun from the Equinoctial point, which is nearest unto it, by the Sine of the complement of the greatest declination, and divide the Product by the total Sine, the Quotient is the Tangent of the right ascention of the Sun, for which if you seek in the Table of Tangents, the Arch answering unto it, is your desire: For example, the Sun being in the first of Taurus, to know the right ascention thereof, I multiply 5773502, the Tangent of 30 degrees (for that 30 degrees is the distance of the Sun from the Equinoctial point) by 9172920, the Sine of 66 degrees, 32′, which is the complement of 23 degrees, 28′, the greatest declination, the Product is 52959871965840, which being divided by 10000000, the totall

tall Sine, the Quotient is 5295987, which is the nereſt Tangent of 27 degrees, 54′, which is the right aſcention of the Sun, being entred into Taurus.

4 How to finde out the declination of the Sunne, knowing only the right aſcention thereof.

Multiply the Tangent of the complement of the greateſt declination by the totall Sine, and divide the Product by the Sine of the right aſcention given, the Quotient is the Tangent of the complement of the Suns declination: for example, the right aſcention of the Sun being 27 degrees, 54′, I would know the declination thereof, multiplying 23035062, the Tangent of 66 degrees, 32′, the complement of 23 degrees, 28′, by 10000000, the Product is 230350620000000, which being divided by 4679298, the Sine of the given aſcention, the Quotient is 492276, the Arch of which Tangent is 78 degrees, 31′, which being ſubducted out of 90, the remaynder is 11 degrees, 29′, and ſo much is the declination of the Sunne.

5 How to finde the place of the Sunne, knowing only the right aſcention thereof.

Subduct the right aſcention given out of 90, if it be leſſe than 90, but if the ſame be more than 90, but leſſe than 180, ſubduct the aſcention given out of 180, and being greater than 180, ſubduct the ſame out of 270, or being greater than 270, ſubduct the ſame from 360, and multiply the Tangent of the remaynder by the Sine of the complement of the greateſt declination, & divide the Product by the totall Sine, the Quotient is the Tangent of the complement of the Suns diſtance from one of the Equinoctiall points: which diſtance being knowne, the place of the Sunne may eaſily be knowne. For example, ſuppoſing the right aſcention of the Sun to be 27 degrees, 54′, the complement thereof is 62 degrees, 6′, the Tangent whereof is 1888671 5, which being multiplyed by 9173929, the Sine of 66 degrees, 32′, the complement of the greateſt declination, the Product is 1732459857577800, which being

being divided by 10000000, the Quotient is 17324598. For which I looke in the Table of Tangents, and I finde the Arch thereof to be 60, the complement whereof is 30, which is the distance of the Sun from the Equinoctiall point, that is, from Aries, for that the right ascention is lesse than 90. I say then that the Sun is in the beginning of Taurus. But if the right ascention had bin more than 90, and lesse than 180, the place of the Sun had bin betwixt Cancer and Libra, 30 degrees from Libra, so should it have bin in the first point of Virgo: but if the right ascention had bin more than 180, the place of the Sun should be betwixt Libra and Capricorne, that is, in the beginning of Scorpio, but being more than 270, the place of the Sun should be betwixt Capricorne and Aries, that is, in the beginning of Pisces.

6 To finde out the ascentionall difference of the Sunne, or any starre in the firmament, knowing the declination thereof, and also the latitude of your Region.

Multiply the Tangent of the declination of the Sunne or Starre by the Tangent of the latitude of the place, and divide the Product by the totall Sine: the Sine of the Quotient is the Sine of the ascentionall difference, the Arch whereof is the desired ascentionall difference. For example, let the declination of the Sun, Starre, or other point in the firmament, be 10 degrees 3', and suppose the latitude to be 52 degrees, the Tangent of 10 degrees 3', is 1772268, the Tangent of 52 degrees, is 12799416, which being multiplyed together, the Product will be 22674995395488, which being divided by 10000000, the totall Sine, the Quotient is 2267499, for which number I looke among the Sines, the Arch answering thereunto, is 13 degrees, 6', which is the ascentionall difference desired.

7 To finde out the oblique ascention of the Sunne.

Knowing the place of the Sun, finde out the right ascention of the same by the third proposition, and finde also the ascentionall difference of the same point, then if the declination of

the

the Sunne be Northh, subduct the aſcentionall difference out of the right aſcention, the remaynder is the oblique aſcention. For example, ſuppoſe the Sunne to be in the beginning of Taurus, now to finde the oblique aſcention thereof in the latitude of 52 degrees, firſt, by the third propoſition, I find out the right aſcention of the beginning of Taurus, which I finde to be 27 degrees, 54′, then by the firſt propoſition I find the aſcentionall difference to be 13 degrees, 6′, which being ſubducted from 27 degrees, 54′, the right aſcention (for that the declination is North) the remaynder is 14 degrees, 48′, and ſo much is the oblique aſcention for the latitude of 52 degrees. But if the Sunne be in any of the Southerne Signes, and that the declination be South, then the aſcentionall difference is to be added to the right aſcention before given.

8 *To finde out the oblique deſcention of the Sun at any time.*

FIrſt, finde out the right aſcention of the Sunne by the third propoſition, the ſame ſhall be the right deſcention thereof: then finde the aſcentionall difference by the firſt propoſition, and if the Sunne be in any of the Northerne Signes, adde the aſcentionall difference unto the right aſcention, the ſum ſhall be the oblique deſcention of the Sunne: but if it be in any of the Southerne Signes, ſubduct the aſcentionall difference out of the right aſcention, the remaynder is the deſired deſcention: as for example, the Sunne being in the beginning of Taurus, the right aſcention thereof by the third propoſition is 27 degrees, 54′, the aſcentionall difference thereof by the firſt propoſition is 13 degrees, 6′, for aſmuch then as Taurus is a Northerne Signe, I adde the aſcentionall difference unto the right aſcention, the ſum is 24 degrees, 58′, and ſo much is the oblique deſcention of the Sunne, being in the beginning of Taurus.

9. *To finde out the length of the day or night.*

HAving found out the aſcentionall difference by the firſt propoſition, adde the ſame unto 90, if the Sunne be in any

of

of the Northerne Signes, but if it be in any of the Southerne Signes, ſubduct the aſcentional difference out of 90, then diuide the ſumme of the addition, or the remaynder of the ſubtraction by 15, the Quotient will ſhewe the half length of the day in houres and minutes, which being doubled, you ſhall haue the whole length of the artificiall day: For example, the Sunne being in the beginning of Taurus, the aſcentionall difference therof is 13 degrees, 6′, which for that the Sun is in a Northerne Signe, I adde unto 90 degrees, the ſumme is 103 degrees, 6′, which being diuided by 15, the Quotient is 6 houres, 52′, the halfe length of the day, which being doubled, will be 13 houres, 42′, the whole length of the artificiall day, in the latitude of 52 degrees.

10 *To finde out the houre of the Sunne, his riſing or ſetting in the latitude aſſigned.*

FInde out the halfe length of the artificiall day by the 9 propoſition, and ſubtract the ſame from 12 houres, the remaynder will ſhewe the houre of the Sunnes riſing: For example, the Sunne being in the beginning of Taurus, to know the houre of his riſing in the latitude of 52 degrees, by the ninth propoſition the halfe length of the artificiall day I finde to be 6 houres, 52′, which I ſubtract from 12 houres, the remaynder is 5 houres, 8′, which ſheweth that the Sunne riſeth at 5 of the clocke and 8′ in the morning, but the halfe length of the day it ſelfe is the houre of the Sunnes ſetting.

11 *To finde out the length of the Planetary houres, and to finde what Planet raigneth at any houre of the day.*

FIrſt finde out the length of the artificiall day by the ninth propoſition, and diuide the ſame by 12, the Quotient is the length of one Planetary houre: or thus, hauing an houre of the artificiall day giuen, looke what houre the ſame is from the Sunne riſing, and multiply the ſame by 12, diuide the Product by the length of the artificiall day, the Quotient is the number of the Planetary houre. For example, the Sunne being in 30 minutes

minutes of Taurus, and our latitude being 52 degrees, the length of the artificiall day by the ninth proposition is 14 houres: then do I divide 14 by 12, the Quotient is $1\frac{1}{6}$, that is, 1 houre, 10', the length of one Planetary houre. But if an houre of the artificial day be given, as that I would know what Planetary houre it is at nine of the clock, the Sun being in the first of Taurus, in the latitude of 52 degrees, having found that the Sunne riseth at 5 of the clocke, by the tenth proposition, I see that 4 houres of the artificiall day are gone at nine of the clocke, I therfore multiply 12 by 4, the Product is 48, which I divide by 14, the length of the artificiall day, the Quotient is $3\frac{3}{7}$, which is the Planetary houre at the time set downe: likewise you shall finde the Planetary houre of the night, finding the length thereof, and then worke with it as was shewed before for the day.

Now to know what Planet raigneth at any houre of the day or night, is plainly set downe in the 52 Chapter, which is the last Chapter of my second Booke of the Spheare.

12 *To finde the Arch of the Equinoctiall, comprehended betwixt the Meridian and any Circle of Position, according unto* Campanus *and* Gazula.

MUltiply the Sine of the Complement of your latitude by the Tangent of the distance of the given Circle of Position from the Zenith, & divide the Product by the totall Sine, the Quotient is the Tangent of the Arch of the Equinoctial, which is comprehended betwixt the given Circle of Position, and the Meridian. For example, in the latitude of 52, I would know what part of the Equinoctiall is comprehended betwixt the Meridian and that Circle of Position, which is 30 degrees from the Zenith: the latitude being 52 degrees, the complement therof is 38 degrees, the Sine wherof is 6156615, and the Tangent of 30 degrees (for that 30 is the distance betwixt the given Circle of Position and the Zenith) is 5773502, which being multiplied by 6156915, the Product is 35545229015730, which being divided by 10000000, the totall Sine, the Quotient is 3554522, for which

I seeke among the Tangents, and I finde the Arke answering thereunto, to be 19 degrées, 34′, the Arch of the Equinoctiall, betwixt the Meridian and the given Circle of Position.

13 *Knowing the Latitude of your Region, and also the Elevation of the Pole above any Circle of Position, how to finde the Inclination of the said Circle of Position unto the Meridian, and so consequently the Arch of the Equinoctiall, which is betwixt the said Circle of Position and the Meridian.*

Multiply the Secant of the complement of the Elevation of the Pole above the Circle of Position, by the Sine of your latitude, and divide the Product by the totall Sine, the Motient is the Secant of the complement of the inclination of the Circle of Position unto the Meridian, and that is the distance betwixt the Circle of Position and the Zenith, by helpe whereof you shall finde the Arch of the Equinoctiall, betwixt the Circle of Position and Meridian, as in the former proposition. As for example, suppose the elevation of the Pole above the Circle of Position in our latitude of 52 to be 23 degrées, 12′. Now to finde out the inclination of that Circle of Position unto the Meridian, first I multiply 25384445, the Secant of 66 degrées, 48′, (for that is the complement of 23 degr. 12′, the elevation of the Pole above the Circle of Position) by 7880108, the Sine of 52, the latitude of our Region, the Product is 200032168120060 which being divided by 10000000, the Quotient is 20003216, for which I looke in the Table of Secants, and the Arch thereof nearest is 60, degrées 0′, the complement whereof is 30 degrées, 0′, which is the inclinaton of the Circle of Position unto the Meridaian, or the distance of the Zenith from the said Circle, then to finde the Arch of the Equinoctiall betwixt the said Circle of Position and the Meridian, repeat the worke of the former proposition.

14 *To finde out the Elevation of the Pole above any assigned Circle of Position in any given latitude.*

KNowing the Inclination of the assigned Circle of Position unto the Meridian, multiply the Secant of the complement thereof by the totall Sine, and divide the Product by the Sine of your latitude, the Quotient is the Secant of the complement of the Elevation of the Pole above the gibien Circle of Position: as for example, suppose the Inclination of a Circle of Position to be 30 degrees 0′. Now to finde the Elevation of the Pole above the same for the latitude of 52 degrees, 0′. First take the complement of 30 degrees 0′, which is 60 degrees 0′, the Secant whereof is 20000000, which being multiplyed by the totall Sine, the Product is 200000000000000, which being divided by 7880108 the Sine of 52 the assigned latitude, the Quotient is 25380362, for which I seeke in the Table of Secants, and the Arch answering thereunto, I finde to be 66 degrees, 48′, the complement whereof is 23 degrees, 12′, and so much is the Elevation of the Pole above the assigned Circle of Position in your latitude.

To

To finde the proportionall parts when the Sine is not preciſely found in the Tables.

If you ſhall not finde in the Canon, the Sine which by your calculation is found; for that you may take the Sine next leſſer or greater, (for example ſake) if by calculation you finde the Sine 50786, conferre that with the Sines 50779 and 50804, put in the Canon, by ſubtracting the one from the other thus;

50786	50804
50779	50786
7	18

And ſeeing you perceive that the Sine 50786 to differ leſſe from the Sine 50879 than from the Sine 50804, I ſay the arke or angle 30 *d.* 31′ agreeth to that, which arke or angle in the Canon you ſhall perceive to bee aſcribed to the Sine 50779.

The ſame reaſon is to be obſerved in the uſe of the Tables of Tangents and Secants.

Now if you deſire to proceed to the proportionall part, and to have ſecond ſcruples, Then ſubtract the leſſer tabulary Sine from the greater, and the remaynder ſhall bee the firſt number in the rule of proportion, and 60 ſeconds the ſecond number, the former leſſer difference the third, being that found by calculation.

50786	50804	50804
50779	50786	50779
7	18	25

25 —— 60″ —— 7

7

420

Then say, the arke belonging to the Sine found is 30 *d.* 31', 16".

25 —— 60" —— 18
60
1080

0(5
1080 (43"
875
25

The arke belonging to the Sine 50786 is 30 *d.* 31', 43".

THE

THE TABLE OF
RIGHT SINES,
FOR EVERY MINVTE OF THE QVADRANT.

First calculated
By I. REGIO MONTANVS.

But lately examined, and in many places corrected and amended according to
BARTHO. PITISCVS.

	0	1	2	3	4	
0	0000	174524	348995	523360	697565	60
1	2909	177433	351902	526265	700467	59
2	5818	180341	354809	529170	703369	58
3	8727	183250	357716	532075	706270	57
4	11636	186158	360623	534980	709172	56
5	14544	189066	363530	537884	712073	55
6	17453	191975	360437	540789	714975	54
7	20362	194883	369344	543694	717876	53
8	23271	197792	372251	549568	720777	52
9	26180	200700	375158	549503	723678	51
10	29088	203608	378064	552407	726579	50
11	31997	206517	380971	555312	726480	49
12	34906	209425	383878	558216	732381	48
13	37815	212333	386785	561120	735282	47
14	40723	215241	389692	564024	738183	46
15	43632	218149	392598	566928	741084	45
16	46541	221057	395505	569832	743985	44
17	49450	223965	398412	572736	746886	43
18	52359	226873	401318	575640	749787	42
19	55268	229781	404225	578544	752688	41
20	58177	232689	407131	581448	755588	40
21	61086	235597	410038	584352	758489	39
22	63995	238505	412944	587256	761389	38
23	66904	241412	415851	590160	764290	37
24	69813	24432	418757	593064	767190	36
25	72721	247229	421663	595967	770090	35
26	75630	250137	424570	598871	772991	34
27	78539	253045	427476	601775	775891	33
28	81448	255953	430381	604678	778791	32
29	84357	258861	433288	607582	781691	31
30	87265	261769	436194	610485	784591	30
	89	88	87	86	85	

	0	1	2	3	4	
30	87265	261769	436194	610485	784591	30
31	90174	264677	439100	613389	787491	29
32	93083	267585	442006	616292	790391	28
33	95992	270493	44491:	619196	793291	27
34	98901	273401	447818	622099	796191	26
35	101809	276309	450724	625002	799090	25
36	104718	278216	453630	627905	801990	24
37	107627	282124	456536	630808	804889	23
38	110536	285032	459442	633711	807786	22
39	113445	287940	462348	636614	810688	21
40	116353	290847	465254	639517	813587	20
41	119262	293755	468159	642420	816486	19
42	122171	296663	471065	645323	819385	18
43	125079	299570	473970	648226	822284	17
44	127988	302478	476876	651129	825183	16
45	130896	305385	479781	654031	828982	15
46	133805	308293	482687	656934	830981	14
47	136714	311200	485592	656837	833880	13
48	139622	314108	488498	662739	836778	12
49	142531	317015	491403	665642	839677	11
50	145439	319922	494308	668544	842576	10
51	148348	322830	497214	671447	845574	9
52	151257	325737	500119	674349	848372	8
53	154165	328645	503024	677251	851271	7
54	157074	331552	505929	680153	854169	6
55	159982	334459	508834	683055	857067	5
56	162891	337367	511740	685957	859965	4
57	165799	340274	514645	688859	862863	3
58	168708	343181	517550	691761	865761	2
59	171616	346088	520455	694663	868659	1
60	174524	348995	523360	697565	871557	0
	89	88	87	86	85	

	5	6	7	8	9	
0	871557	1045285	1218693	1397331	1564345	60
1	874455	1048178	1221580	1394612	1567218	59
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2	9849087	9877792	9903489	9926169	9945826	58
3	9849590	9878245	9903892	9926521	9946128	57
4	9850093	9878697	9904294	9926873	9946429	56
5	9850595	9879148	9904695	9928224	9946729	55
6	9851096	9879598	9905095	9927574	9947028	54
7	9851595	9880048	9905494	9927923	9947327	53
8	9852092	9880497	9905893	9928271	9947625	52
9	9853590	9880945	9906291	9928618	9947922	51
10	9853087	9881392	9906688	9928965	9948218	50
11	9853583	9881838	9907084	9929311	9948513	49
12	9854079	9882283	9907479	9929656	9948807	48
13	9854574	9882728	9907873	9930000	9949100	47
14	9855058	9883172	9908266	9930343	9949393	46
15	9855561	9883615	9908659	9930685	9949685	45
16	9856053	9884057	9909051	9931026	9949976	44
17	9856544	9884498	9909442	9931367	9950266	43
18	9857035	9884938	9909832	9931707	9950555	42
19	9857525	9885378	9910221	9932046	9950844	41
20	9858014	9885817	9910610	9932384	9951132	40
21	9858502	9886255	9910998	9932721	9951419	39
22	9858985	9886692	9911385	9933057	9951705	38
23	9859475	9887128	9911771	9933392	9951990	37
24	9859961	9887564	9912156	9933728	9952274	36
25	9860446	9887999	9912540	9934062	9952557	35
26	9860930	9888433	9912923	9934395	9952840	34
27	9861413	9888866	9913306	9935727	9953122	33
28	9861895	9889298	9913688	9935058	9953403	32
29	9862376	9889729	9914069	9935389	9953683	31
30	9862856	9890159	9914449	9935719	9953962	30
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31	9863336	9890588	9914828	9936048	9954240	29
32	9863815	9891017	9915206	9936376	9954518	28
33	9864293	9891445	9915583	9936703	9954795	27
34	9864770	9891872	9915961	9937029	9955071	26
35	9865246	9892298	9916337	9937356	9955346	25
36	9865722	9892723	9916712	9937680	9955620	24
37	9866179	9893147	9917086	9938004	9955893	23
38	9866671	9893571	9917459	9938327	9956165	22
39	9867144	9893994	9917832	9938649	9956437	21
40	9867616	9894416	9918204	9938970	9956708	20
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42	9868557	9895257	9918945	9939609	9957247	18
43	9869027	9895677	9919314	9939928	9957515	17
44	9869496	9856096	9919682	9940246	9957782	16
45	9869964	9896514	9920049	9940563	9958049	15
46	9870431	9896931	9920416	9940879	9958315	14
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48	9871362	9897762	9921147	9941509	9958844	12
49	9871827	9898177	9921511	9941823	9959107	11
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51	9872754	9899004	9922236	9942448	9959632	9
52	9873216	9899416	9922598	9942758	9959893	8
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56	9875056	9901055	9924036	9943996	9960927	4
57	9875514	9901463	9924393	9944303	9961183	3
58	9875971	9901870	9924750	9944610	9961438	2
59	9876427	9902276	9925106	9944915	9961693	1
60	9876883	9902681	9925461	9945219	9961947	0
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4	9962954	9976446	9986897	9994307	9998673	56
5	9963204	9976645	9987045	9994405	9998720	55
6	9963453	9976843	9987193	9994502	9998766	54
7	9963701	9977040	9987340	9994598	9998811	53
8	9963948	9977237	9987486	9994693	9998855	52
9	9964194	9977434	9987631	9994787	9998899	51
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11	9964685	9977822	9987918	9994974	9998984	49
12	9964929	9978015	9988061	9995066	9999025	48
13	9965172	9978207	9988203	9995157	9999065	47
14	9965414	9978398	9988344	9995247	9999104	46
15	9965655	9978589	9988484	9995336	9999143	45
16	9966895	9978779	9988623	9995424	9999181	44
17	9966135	9978968	9988761	9995512	9999218	43
18	9966374	9979156	9988899	9995599	9999254	42
19	9966612	9979343	9989036	9995685	9999289	41
20	9966849	9979530	9989172	9995770	9999323	40
21	9967085	9979716	9989307	9995854	9999356	39
22	9967320	9979901	9989441	9995937	9999389	38
23	9967555	9980083	9989574	9996019	9999421	37
24	9967789	9980268	9989706	9996101	9999452	36
25	9968021	9980450	9989837	9996182	9999482	35
26	9968254	9980631	9989968	9996262	9999511	34
27	9968485	9980811	9990098	9996341	9999539	33
28	9968715	9980992	9990227	9996419	9999566	32
29	9968944	9981169	9990355	9996496	9999593	31
30	9969173	9981348	9990482	9996573	9999619	30
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33	9969854	9981877	9990859	9996798	9999691	27
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36	9970528	9982399	9991228	9997014	9999756	24
37	9970751	9982571	9991349	9997085	9999776	23
38	9970973	9982742	9991470	9997155	9999795	22
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41	9971633	9983251	9991827	9997359	9999846	19
42	9971851	9983419	9991944	9997425	9999862	18
43	9972069	9983586	9992060	9997491	9999877	17
44	9972286	9983752	9992175	9997556	9999891	16
45	9972502	9983917	9992290	9997620	9999904	15
46	9972717	9984081	9992404	9997683	9999916	14
47	9972931	9984245	9992517	9997745	9999927	13
48	9973145	9984408	9992629	9997806	9999938	12
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51	9973781	9984891	9992960	9997986	9999965	9
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56	9974822	9985680	9993495	9998267	9999993	4
57	9975028	9985835	9993599	9998321	9999996	3
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60	9975640	9986295	9993908	9998477	1000000	0
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84	85	86	87	88	89

THE TABLE OF
TANGENTS
FOR EVERY MINVTE OF THE QVADRANT.

First calculated
By I. REGIO MONTANVS.

But lately examined, and in many places corrected and amended according to
BARTHO. PITISCVS.

	0	1	2	3	4	
0	0000	174450	349297	524078	699269	60
1	2909	177459	352120	526995	702193	59
2	5818	180369	355033	529911	705116	58
3	8727	183270	357945	532828	708039	57
4	11636	186189	360858	535745	710962	56
5	14544	189100	363770	538663	713886	55
6	17453	192010	366683	541580	716809	54
7	20361	194920	369596	544498	719733	53
8	23270	197830	372508	547415	722657	52
9	26179	200740	375421	550333	725580	51
10	29088	203650	378324	553251	728504	50
11	31996	206561	381247	556169	731428	49
12	34905	209471	384160	559087	734353	48
13	37814	212381	387073	562005	737277	47
14	40723	215291	389987	564923	740202	46
15	43632	218201	392900	567841	743127	45
16	46541	221111	395814	570759	746052	44
17	46450	224022	398727	573678	748978	43
18	52359	226932	401641	576596	751903	42
19	55268	229842	404554	579514	754829	41
20	58177	232752	407468	582433	757754	40
21	61086	235663	410381	585352	760680	39
22	63995	238574	413295	588270	763606	38
23	66904	241485	416209	591189	766533	37
24	69813	244395	419123	594108	769459	36
25	72722	247306	422037	597028	772385	35
26	75631	250217	424951	599947	775311	34
27	78540	253128	427866	602866	778238	33
28	81450	256038	430780	605786	781164	32
29	84359	258949	433694	608705	784091	31
30	87268	261859	436609	611625	787017	30
	89	88	87	86	85	

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31	90177	264770	439524	614544	789944	29
32	93086	267681	442438	617464	792871	28
33	95995	270592	445353	620384	795799	27
34	98904	273503	448267	623304	798726	26
35	101813	276414	451182	626225	801653	25
36	104723	279325	454097	629145	804581	24
37	107632	282237	457012	632061	807509	23
38	110541	285848	459996	634986	810437	22
39	113450	288059	462842	637907	813365	21
40	116360	290970	465757	640828	816293	20
41	119269	293882	468672	643749	819221	19
42	122178	296794	471588	646671	822150	18
43	125088	299705	474503	649592	825079	17
44	127997	302617	477419	652514	828008	16
45	130906	305528	480335	655435	830937	15
46	133816	308439	483251	658357	833866	14
47	136725	311351	486166	661278	836795	13
48	139635	314263	489082	664200	839724	12
49	142544	317174	491997	667121	842653	11
50	145454	320085	494913	670043	845582	10
51	148363	322997	497829	672905	848513	9
52	151273	325909	500745	675888	851443	8
53	154182	328821	503662	678810	854374	7
54	157092	33173	506578	681723	857304	6
55	160001	33464	509495	684656	860234	5
56	162911	337558	512411	687578	863164	4
57	165820	340470	515328	690501	866095	3
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59	171640	346295	521161	696346	871956	1
60	174550	349207	524078	699269	874886	0
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3	883680	1059866	1236704	1414308	1592791	57
4	886611	1062808	1239658	1417275	1595774	56
5	889543	1065750	1242612	1420242	1598757	55
6	892475	1068692	1245566	1423210	1601746	54
7	895407	1071634	1248520	1426178	1604723	53
8	898339	1074576	1251474	1429146	1607707	52
9	901271	1077518	1254428	1432115	1610691	51
10	904204	1080461	1267383	1435084	1613675	50
11	907137	1083404	1260338	1438053	1616660	49
12	910070	1086347	1263293	1441022	1619645	48
13	913003	1089291	1266249	1443952	1622630	47
14	915936	1092234	1269205	1446961	1625615	46
15	918870	1095178	1272161	1449931	1628601	45
16	921804	1098122	1275117	1453701	1631587	44
17	924738	1101066	1278073	1455871	1634573	43
18	927671	1104010	1281029	1458842	1637560	42
19	930605	1106954	1283986	1461813	1640547	41
20	933539	1109899	1286943	1464784	1643534	40
21	936473	1112844	1289900	1467754	1646522	39
22	939407	1115789	1292857	1470727	1649510	38
23	942342	1118734	1295815	1473699	1652499	37
24	945277	1121680	1298773	1476671	1655488	36
25	948212	1124625	1301731	1479644	1658477	35
26	951147	1127571	1304689	1482617	1661466	34
27	954083	1130517	1307648	1485590	1664456	33
28	957019	1133463	1310607	1488563	1667446	32
29	959954	1136409	1313566	1439536	1670436	31
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30	962890	1139355	1316525	1494510	1673426	30
31	965826	1142302	1310485	1497484	1676417	29
32	968763	1145249	1322445	1500458	1679408	28
33	971699	1148196	1325405	1503433	1682399	27
34	974636	1151144	1328365	1506408	1685390	26
35	977573	1154091	1331325	1509383	1688382	25
36	980509	1157030	1334285	1522358	1691374	24
37	983446	1159988	1337246	1515334	1694366	23
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39	989320	1165884	1343168	1521286	1700351	21
40	992257	1198832	1346129	1524262	1703344	20
41	995195	1171781	1349091	1527239	1706337	19
42	998133	1174730	1352053	1530216	1709331	18
43	1001072	1177679	1355015	1533193	1712325	17
44	1004010	1180628	1357977	1536170	1715319	16
45	1006949	1183577	1360940	1539148	1718313	15
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47	1012825	1189477	1366866	1545104	1724304	13
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54	1033399	1210132	1387615	1565959	1745278	6
55	1036339	1213084	1390580	1568939	1748275	5
56	1039279	1216036	1393545	1571920	1751273	4
57	1042219	1218988	1396510	1574901	1754271	3
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3	1772268	1952861	2134687	2317875	2502552	57
4	177526.	1955881	2137729	2320940	2505643	56
5	1778270	1958901	2140771	2324006	2508735	55
6	1781271	1961922	2143814	2327072	2511827	54
7	1784271	1964943	2146857	2330139	2514920	53
8	1787274	1967964	2149900	2333206	2518013	52
9	1790276	1970985	2152944	2336273	2521106	51
10	1793278	1974007	2155988	2336341	2524200	50
11	1796281	1977029	2159032	2342409	2527294	49
12	1799284	1980052	2162077	2345478	2530389	48
13	1802287	1983075	2165122	2348547	2533484	47
14	1805291	1986098	2168167	2351616	2536580	46
15	1808295	1989122	2171213	2354686	2539676	45
16	1811299	1992146	2174259	2357757	2542773	44
17	1814303	1995171	2177306	2360828	2545870	43
18	1817308	1998196	2180352	2363899	2548968	42
19	1820313	2001221	2183400	2366971	2552066	41
20	1823318	2004247	2186448	2370043	2555165	40
21	1826324	2007273	2189496	2373116	2558264	39
22	1829329	2010299	2192544	2376189	2561364	38
23	1832335	2013326	2195593	2379263	2564464	37
24	1835342	2016353	2198643	2382337	2567564	36
25	1838349	2019380	2201692	2385411	2570665	35
26	1841357	2028408	2204742	2388486	2573766	34
27	1844365	2025436	2207792	2391561	2576868	33
28	1847373	2028464	2210843	2394636	2579970	32
29	1850382	2031494	2213894	2397712	2583073	31
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31	1856400	2037552	2219998	2403865	2589280	29
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33	1802419	2043612	2226104	2410020	2595489	27
34	1865429	2046643	2229157	2413098	2598594	26
35	1868439	2049674	2232211	2416176	2601700	25
36	1871449	2052705	2235265	2419255	2604806	24
37	1874460	2055737	2238319	2422334	2607912	23
38	1877471	2058769	2241374	2425414	2611019	22
39	1880482	2061801	2244429	2428494	2614126	21
40	1883494	2064834	2247485	2431574	2617234	20
41	1886506	2067867	2250541	2434655	2620342	19
42	1889518	2070900	2253597	2437736	2623451	18
43	1892531	2073934	2256654	2440818	2626560	17
44	1895544	2076968	2269711	2443900	2629670	16
45	1898558	2080002	2262766	2446983	2632780	15
46	1901572	2082337	2265827	2450066	2635891	14
47	1904586	2086073	2268885	2453150	2639002	13
48	1907601	2089109	2271944	2456234	2642114	12
49	1910616	2092145	2275003	2459319	2645226	11
50	1913632	2095182	2278063	2462404	2648339	10
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52	1919664	2101256	2284183	2468576	2654566	8
53	1922680	2104293	2287244	2471662	2657680	7
54	1925697	2107331	2290304	2474749	2660795	6
55	1928714	2110369	2293367	2477836	2663910	5
56	1931731	2113407	2296429	2480924	2667026	4
57	1934749	2116446	2299492	2484012	2670142	3
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59	1940785	2122525	2305618	2490191	2676375	1
60	1943803	2125565	2308682	2493280	2679491	0
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2	2685728	2873749	3063669	3255630	3449785	58
3	2688847	2876898	3066851	3258848	3453040	57
4	2691966	2880048	3070034	3262066	3456296	56
5	2695086	2883198	3073218	3265285	3459553	55
6	2698206	2886249	3076402	3268504	3462810	54
7	2701327	2889501	3079587	3271724	3466068	53
8	2704448	2892653	3082772	3274944	3469326	52
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27	125659878	161189849	224540987	33
28	126123842	161952305	226020167	32
29	126591211	162721698	227518902	31
30	127062036	163498660	229037584	30
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30	127062036	163498660	229037584	30
31	127536341	164282764	230576614	29
32	128014165	165074651	232136427	28
33	128495548	165873906	233717425	27
34	128980531	166811772	235320041	26
35	129469305	167496287	236945285	25
36	129961652	168319085	238592501	24
37	130457692	169150247	240262714	23
38	130957670	169989613	241957021	22
39	131461286	170837304	243674732	21
40	131968930	171693461	245417543	20
41	132480297	172558 98	247184785	19
42	132995769	173431641	248978216	18
43	133515636	174313925	250797165	17
44	134038804	175205183	252643455	16
45	134566419	176105555	254517088	15
46	135098143	177015180	256417991	14
47	135634096	177934219	258348100	13
48	136174272	178862806	260307416	12
49	136718731	179891085	262296605	11
50	137267523	180749537	264316358	10
51	137820702	181707670	266366704	9
52	138378319	182676299	268449755	8
53	138940429	183654941	270565570	7
54	139507087	184644417	272714927	6
55	140078545	185644562	274898633	5
56	140654481	186655202	277117516	4
57	141235334	187677270	279372435	3
58	141820765	188710414	281664304	2
59	142411234	189755028	283994009	1
60	143006601	190811200	286362498	0
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2	291219764		5926557130	58
3	293710598		6030570150	57
4	296244357		6138259940	56
5	298823024		6249903110	55
6	301445987		6365640400	54
7	304115322		6485915090	53
8	306833212		6610547280	52
9	309599077		6740164350	51
10	312416191		6875007250	50
11	315283945		7015334740	49
12	318204757		7161496760	48
13	321191137		7313855930	47
14	324212583		7472893640	46
15	327302782		7638998130	45
16	330451272		7812592590	44
17	333661982		7994321990	43
18	336934467		8184637920	42
19	340272744		8384304380	41
20	344677949		8593953740	40
21	347150587		8814276520	39
22	350695255		9046272610	38
23	354312962		9290810860	37
24	358006024		9548933320	36
25	361776788		9821805530	35
26	365626388		10110626790	34
27	369560062		10417054540	33
28	373579199		10742638990	32
29	377686614		11089220840	31
30	381885288		11458911360	30
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30	381885288		1145891136	30
31	386178258		1185395877	29
32	390568737		1227736470	28
33	395060088		1273213435	27
34	399655828		1322188681	26
35	404359642		1375082163	25
36	409175388		1432363027	24
37	414111295		1494645462	23
38	419159137		1562590046	22
39	424335793		1637005697	21
40	429641796		1718863124	20
41	435082056		1809337410	19
42	440661780		1909864971	18
43	446386310		2022219818	17
44	452261453		2148619711	16
45	458293185		2291873854	15
46	464487853		2455533838	14
47	470852152		2644433955	13
48	477393195		2864819229	12
49	484118353		3125276745	11
50	491038024		3437829002	10
51	498155754		3819696333	9
52	505482730		4297181900	8
53	513020946		4911098124	7
54	520805157		5729633839	6
55	528821258		6875680006	5
56	537085003		8594003953	4
57	545610968		11457529506	3
58	554414914		17188032688	2
59	563504309		34376070815	1
60	572899830		INFINITA.	0
	1		0	

THE TABLE OF
SECANTS
FOR EVERY MINVTE
OF THE QVADRANT.

First calculated
By I. REGIO MONTANVS.

But lately examined, and in many places corrected and amended according to
BARTHO. PITISCVS.

	0	1	2	3	
0	10000000	10001524	10006095	10013723	60
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2	10000002	10001626	10006301	10014029	58
3	10000004	10001679	10006405	10014184	57
4	10000008	10001733	10006509	10014339	56
5	10000010	10001788	10006615	10014495	55
6	10000014	10001844	10006721	10014653	54
7	10000020	10001900	10006828	10014811	53
8	10000027	10001957	10006936	10014970	52
9	10000034	10002015	10007045	10015130	51
10	10000042	10002074	10007155	10015291	50
11	10000051	10002134	10007265	10015453	49
12	10000060	10002193	10007376	10015615	48
13	10000071	10002256	10007488	10015780	47
14	10000089	10002318	10007601	10015942	46
15	10000005	10002381	10007716	10016107	45
16	10000108	10002445	10007831	10016273	44
17	10000122	10002508	10007946	10016440	43
18	10000137	10002576	10008062	10016608	42
19	10000152	10002642	10008179	10016777	41
20	10000168	10002709	10008298	10016946	40
21	10000186	10002777	10008417	10017616	39
22	10000204	10002846	10008537	10017287	38
23	10000220	10002916	10008658	10017459	37
24	10000243	10002987	10008779	10017632	36
25	10000264	10003058	10008902	10017806	35
26	10000285	10003130	10009025	10017981	34
27	10000308	10003203	10009149	10018157	33
28	10000332	10003277	10009274	10018333	32
29	10000357	10003352	10009400	10018510	31
30	10000381	10003428	10009527	10018687	30
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32	10000433	10003581	10009783	10019044	28
33	10000461	10003660	10009912	10019224	27
34	10000489	10003739	10010042	10019405	26
35	10000518	10003819	10010174	10019587	25
36	10000548	10003900	10010306	10019770	24
37	10000579	10003982	10010439	10019954	23
38	10000611	10004064	10010572	10020138	22
39	10000643	10004148	10010706	10020324	21
40	10000677	10004231	10010841	10020510	20
41	10000711	10004317	10010977	10020698	19
42	10000746	10004403	10011114	10020886	18
43	10000782	10004490	10011252	10021076	17
44	10000819	10004578	10011390	10021266	16
45	10000857	10004666	10011529	10021456	15
46	10000895	10004755	10011670	10021649	14
47	10000934	10004845	10011811	10021842	13
48	10000975	10004936	10011952	10022035	12
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53	10001188	10005405	10012674	10023015	7
54	10001233	10005501	10012822	10023213	6
55	10001280	10005598	10012970	10023412	5
56	10001327	10005696	10013119	10023612	4
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3	10025036	10038968	10056009	10076182	57
4	10025242	10039226	10056320	10076545	56
5	10025450	10039486	10056632	10076909	55
6	10025658	10039747	10056944	10077274	54
7	10025868	10040008	10057256	10077639	53
8	10026078	10040269	10057570	10078005	52
9	10026289	10040532	10057884	10078372	51
10	10026500	10040796	10058200	10078740	50
11	10026713	10041061	10058517	10079109	49
12	10026927	10041326	10058834	10079479	48
13	10027141	10041592	10059153	10079850	47
14	10027357	10041859	10059472	10080222	46
15	10027573	10042128	10059792	10080595	45
16	10027790	10042397	10060113	10080968	44
17	10028009	10042667	10060435	10081342	43
18	10028227	10042936	10060757	10081717	42
19	10028447	10043207	10061080	10082093	41
20	10028667	10043479	10061405	10082470	40
21	10028889	10043752	10061730	10082848	39
22	10029111	10044025	10062056	10083226	38
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24	10029559	10044576	10062711	10083987	36
25	10029784	10044853	10063039	10084368	35
26	10030009	10045130	10063369	10084750	34
27	10030236	10045409	10063700	10085134	33
28	10030463	10045680	10064031	10085518	32
29	10030692	10045969	10064364	10085903	31
30	10030922	10046250	10064696	10086289	30
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31	10031152	10046537	10065032	10086677	29
32	10031381	10046815	10065365	10087065	28
33	10031614	10047098	10065701	10087454	27
34	10031846	10047383	10066038	10087843	26
35	10032079	10047669	10066376	10088233	25
36	10032314	10047954	10066715	10088623	24
37	10032550	10048241	10067054	10089015	23
38	10032786	10048529	10067394	10089408	22
39	10033023	10048818	10067735	10089802	21
40	10033261	10049107	10068076	10090196	20
41	10033500	10049398	10068419	10090592	19
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43	10033981	10049983	10069107	10091385	17
44	10034223	10050276	10069452	10091783	16
45	10034465	10050571	10069798	10092182	15
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47	10034952	10051160	10070495	10092983	13
48	10035196	10051456	10070842	10093385	12
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5	10100351	10126994	10156881	10190058	55
6	10100769	10127465	10157407	10190639	54
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9	10102028	10128884	10158991	10192387	51
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11	10102872	10129834	10160051	10193557	49
12	10103295	10130311	10160582	10194144	48
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16	10104996	10132226	10162717	10196500	44
17	10105423	10132707	10163252	10197092	43
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19	10106280	10133672	10164327	10198277	41
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24	10108438	10136102	10167028	10201258	36
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26	10109309	10137080	10168116	10202457	34
27	10109745	10137571	10168661	10203058	33
28	10110182	10138063	10169207	10203659	32
29	10110620	10138555	10169755	10204262	31
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35	10113269	10141528	10173056	10207897	25
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47	10118663	10147572	10179756	10217268	13
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3	10225305	10265112	10308383	10355186	57
4	10225941	10265804	10309134	10355996	56
5	10226577	10266498	10309886	10356807	55
6	10227215	10267192	10310639	10357619	54
7	10227854	10267888	10311393	10358433	53
8	10228493	10268584	10312148	10359247	52
9	10229134	10269281	10312903	10360063	51
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11	10230417	10270680	10314417	10361698	49
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13	10231704	10272080	10315935	10363337	47
14	10232348	10272782	10316696	10364158	46
15	10232994	10273485	10317457	10364980	45
16	10233641	10274190	10318220	10365802	44
17	10234289	10274895	10318984	10366626	43
18	10234938	10275601	10319749	10367450	42
19	10235587	10276308	10320515	10368276	41
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21	10236889	10277726	10322050	10369930	39
22	10237541	10278436	10322819	10370758	38
23	10238195	10279148	10323589	10371588	37
24	10238849	10279860	10324359	10372418	36
25	10239505	10280575	10325131	10373250	35
26	10240161	10281287	10325903	10374082	34
27	10240818	10282002	10326677	10374916	33
28	10241476	10282717	10327451	10375750	32
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32	10244118	10285589	10330559	10379098	28
33	10244782	10286310	10331339	10379938	27
34	10245445	10287032	10332119	10380778	26
35	10246110	10287754	10332902	10381620	25
36	10246776	10288478	10333684	10382463	24
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38	10248110	10289928	10335252	10384153	22
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46	10253484	10295766	10341564	10390949	14
47	10254162	10296501	10342357	10391803	13
48	10254839	10297237	10343152	10392657	12
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9	10410843	10465330	10523611	10585785	51
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16	10417007	10471933	10530662	10593297	44
17	10417892	10472880	10531673	10594375	43
18	10418778	10473829	10532686	10595455	42
19	10419665	10474778	10533699	10596534	41
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23	10423224	10478587	10537765	10600865	37
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25	10425009	10480498	10539805	10603037	35
26	10425903	10481454	10540826	10604125	34
27	10426798	10482412	10541848	10605214	33
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32	104968474	128404152	165377268	28
33	105288542	128884078	166175067	27
34	105610566	129367704	166980877	26
35	105934564	129854921	167794436	25
36	106260557	130245812	168615879	24
37	106588558	130840395	169445585	23
38	106988589	131338017	170283495	22
39	107250680	131841076	171129720	21
40	107584955	132347264	171984331	20
41	107921201	132857174	172847612	19
42	108259554	123371190	173719600	18
43	108600151	133889600	174600528	17
44	108942779	134411212	175490331	16
45	109287702	134937371	176389247	15
46	109634817	135467649	177197417	14
47	109984143	316002135	178215120	13
48	110335695	136540855	179142431	12
49	110689503	317083887	180079354	11
50	111045497	137621223	181016251	10
51	111403988	138183016	181983028	9
52	111764699	138739177	182949802	8
53	112127750	139299830	183926988	7
54	112493167	139865032	184915309	6
55	112861097	140435034	185913898	5
56	113231316	141009514	186922883	4
57	113604016	141588980	187943832	3
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60	114737188	143355898	191073159	0
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	87	88	89	
0	191073159	286537048	572899698	60
1	192139667	288943948	582697434	59
2	193218144	291391704	592743072	58
3	194308793	293881153	603239919	57
4	195411923	296413687	613910444	56
5	196527529	298990299	625071305	55
6	197656082	301612007	636644580	54
7	198797665	304280287	648655621	53
8	199952408	306996123	661130359	52
9	201120639	309760733	674092521	51
10	202302811	312575792	687573461	50
11	203498943	315442491	701612741	49
12	204709326	318362249	716226489	48
13	205934200	321336674	731457951	47
14	207173596	324367065	747358468	46
15	208428431	327455509	763965262	45
16	209698119	330603045	781327254	44
17	210983811	333811800	799496739	43
18	212284911	337083530	818531878	42
19	213602721	340419952	838493969	41
20	214906837	343823203	859455551	40
21	216287619	347295086	881488374	39
22	217655550	350838099	904688629	38
23	219040992	354454051	929138899	37
24	220443981	358145279	954946691	36
25	221865261	361914168	982231437	35
26	223305005	365763313	1011112129	34
27	234763453	369695332	141756449	33
28	226241278	373713015	1074309940	32
29	227738558	377818495	1108967170	31
30	229255885	382015594	1145030768	30
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	87	88	89	
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33	233931561	395185630	1273252703	27
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36	238802172	409296566	1432397932	24
37	240471230	414226675	1494678912	23
38	242163682	419278406	1562622042	22
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40	245621193	429757156	19188822'2	20
41	247386980	435196961	1809348043	19
42	249178956	440774630	1909068150	18
43	250996850	446498005	2022214532	17
44	252841385	452371994	2148642981	16
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46	256613211	464596485	2455554190	14
47	258541665	470959629	2644450861	13
48	260499426	477499828	2864894681	12
49	262487060	484224119	3125282743	11
50	264505158	491140838	3437843546	10
51	266554448	498256113	3819709423	9
52	268635944	505583634	4297193526	8
53	270750304	513128995	4911255640	7
54	272898206	520902752	5729642566	6
55	275080457	528915798	6875687278	5
56	277297885	537178989	8594018365	4
57	279551349	545704599	11458691197	3
58	281841763	554505291	17188026598	2
59	284170013	563594631	34376072269	1
60	286537048	572899698	INFINITA	0
	2	1	0	

A PLAINE TREATISE OF THE FIRST PRINCIPLES of Cosmography, and specially of the SPHEARE, representing the shape of the whole WORLD.

Together with all the chiefest and most necessary uses thereof.

Written by Mr. BLUNDEVILL.



The Heavens declare the glory of God, and the Firmament sheweth his handy worke. *Psal.* 19.

THE ORDER AND CONTENTS OF THIS TREATISE touching the first Principles of Cosmography, and specially of the SPHEARE.

HAving set downe the exposition of certaine termes of Geometry, for the better understanding of this Treatise, I do first define what Cosmography is, and therewith do briefly shew what Sciences it comprehendeth, and who were first Inventers thereof: that done, because the Spheare doth represent the shape of the whole World, I do define what a Spheare is, and then I do divide the World into two essentiall parts, that is, the Celestiall, and Elementall part, according to which two parts, I do divide this Treatise into two Bookes, the first whereof treateth of the Celestiall part, and the second of the Elementall part of the World, with what order the Chapters of each Booke hereafter following doe plainly shew.

The Chapters and Contents of the first Booke.

OF Cosmography, what it is, and what kinde of Sciences it comprehendeth, and who were first Inventers thereof, *Chap.* 1

The difinition of a Spheare, and the unity, roundnesse, and capicity of the World, also of the Pole and Axeltree thereof, *Chap.* 2

Of the division of the World, and of the two Essentiall parts thereof, and what things each part containeth. *Chap.* 3

A figure of the whole World, wherein are ſet forth the two Eſſentiall parts before mentioned, that is to ſay, the eleven Heavens, and the foure Elements.

A demonſtration to prove the plurality of the Heavens, *Chap.4*

Of the higeſt Spheare or Heaven, called the Imperial Heaven, *Chap.5*

Of the tenth Spheare or Heaven called in Latine *Primum mobile*, that is, he firſt movable, and what motions it hath, *Chap.6*

Of the ninth Heaven, what motions and names it hath, and whether there be any waters above the Firmament or not, *Chap.7*

Of the eighth Heaven, what motions it hath, and what Circles are imagined by the Aſtronomers to bee in that Heaven, and to what uſe and purpoſe they ſerve: Alſo in what time every one of the ſeaven Planets maketh his revolution, and of what thickneſſe their Spheares be. *Chap.8*

Of the Circles, whereof a materiall Spheare conſiſteth, and of their divers diviſions. *Chap.9*

Of the Equinoctial Line, why it is ſo called, and of the divers uſes thereof, *Chap. 10*

A figure ſhewing the Equinoctiall Line, the two Poles, and the Axeltree of the World.

Of the Zodiaque, why it is ſo called, and of the twelve Signes therein contained. Alſo of the Latitude, Longitude, and Declination thereof, *Chap.11*

How much the Zadiaque declineth from the Equinoctiall towards either of the Poles, and of the greateſt Declination of the Sunne, what it is at this preſent, and what it hath beene in times paſt. *Chap.12*

How to know the quantity of the Sunnes Declination bee it Northward or Southward, every day throughout the yeere, as well by a Table, as by a materiall Spheare or Globe, *Chap.13*

An Inſtrument to know thereby in what ſigne or degree the Sunne is every day throughout the yeere.

A Table ſhewing the declination of Sun every day throughout the yeere lately calculated.

Vpon what Poles the Zodiaque turneth about, alſo of the Ecliptique

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Of the two Colures, why they are ſo named, and whereto they ſerve: Alſo of the foure Cardinall points, that is, two the Equinoctiall, and the two Solſtitiall points, and of the entrance of the Sun into any of thoſe points, or into any other Signe, *Chap.* 16
Of the Horizon both right and oblique, making thereby three kinds of Spheares, that is, the right, the parallel, and the oblique Spheare, *Chap.* 17
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Of the verticall Circle and uſes thereof, whereof no mention is commonly made by thoſe that write of the Spheare, *Chap.* 19
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of

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How to finde out by the materiall Spheare or Globe, and by helpe

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Of the Ayre, & into how many Regions it is divided, *Chap.* 3

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A Table shewing the degrees of Latitude in the beginning, midst, and end of every one of the foresaid nine Climes.

A Table shewing the longest day in every degree of Latitude, proceeding orderly from the Equinoctiall to the North Pole, by whole degrees without minutes, from one degree to ninety.

A Table shewing how many miles every one of the seven Climes

climes doe containe, as well in bredth, as in length.

Of the divers seasons and shadowes incident to divers climes and Paralels, and first what seasons and shadowes they have that dwell right nnder the Equinoctiall, *Chap.* 19

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Of the wind, what it is, what motion it hath, and of the divers names and divisions thereof, *Chap.* 28

Of the nature and qualitie of the Ancient twelve Windes, *Chap.* 29

Of the modern division of the Windes, *Chap.* 30

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THE

THE EXPOSITION OF Certain Termes or Principles of GEOMETRY.

MInding to treat of the Principles of Cosmography and especially of the Spheare, I thinke it good first to expound unto you certaine Termes of Geometry, without the which the unlearned shall hardly understand the Contents of this Treatise, which Termes are certaine Principles of Geometry, called Definitions. For there are but three kindes of Principles, whereon the Demonstration of all Geometrical conclusions dependeth: that is Definitions, Petitions, and Maximes; but I minde heere to deale onely with certaine Definitions. Whereof I will set downe as many as I thinke needfull for this purpose in such order as followeth.

1 A point called in Latine punctus, is a thing supposed to be in divisible, having neither length, breadth, nor depth, as the point or pricke A.

A.

2 A line called in Latine linea, is a supposed length having neither breadth, nor thicknesse, as the line AB

A——————B

3 The ends or bounds of a line, are two points, and of lines some be right, and some be crooked.

4 A right line is that which goeth right from

from one point to another, and not bowing by as doth the line c d, but so straight as is possible, as the line a b. Againe, the crooked line is either a whole Circle, or portion of a Circle, or else goeth winding in and out, as a Serpent called in Latine Linea tortuosa, or else winding about like the shell of a Snaile, called of the Latines Linea spiralis, as these figures here do shew.



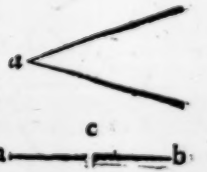
5 Superficies or upperface is that which only hath length and breadth, without depth which is two-fold, that is to say, plaine and crooked.

6 The bounds of Superficies are lines.

7 A plaine Superficies is that which lyeth straight betwixt his lines, as the figure a, and a crooked Superficies is that which goeth bowing & lyeth not straight betwixt his lines, as the figure b. Againe Superficies being considered in an hollow body, as a barrell, Tun, or Vault, may be divided into two other kinds, that is, Conver, and Concave, for the upper part of such a Vault is saye to be Conver and the inward part Concave, as the figure b sheweth.

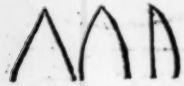


8 A plaine Angle is when two lines being drawn upon a plaine Superficies, not directly one against another, but so as by meeting or touching one another in one selfe point, they may make a plaine Angle, as the Angle a. For if two lines be drawne directly one against another, though they meet in one point, yet they make no Angle, but rather one selfe line as the two lines a b meeting in the point c.



9 Of

Right, crooked, mixt.



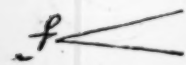


9 Of plaine Angles, some are called right line Angles, because that both the lines whereof it consisteth are right, and some are called crooked line Angles, because that both lines are crooked, and some are said to be mixt, because the one line is crooked and the other right, as you may perceive by the three sundrie shapes thereof made in the Margent.

10 If one right line standing upon another right line, do make two equall Angles, that is to say, of each side one, then either of those Angles are called right Angels, & the line so standing upon his fellow, is called a perpendicular or plumbe line, as the line a b, standing upon the line c d.



11 A blunt Angle, is that which is greater than a right Angle, as the Angle e.



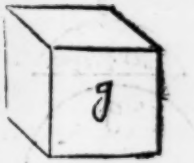
12 A sharp Angle, is that which is lesser then a right Angle, as f, so as there be in all three Angles, that is right, blunt, & sharp, in Latine rectus, obtusus, & acutus: And besides these Angles, there be also certain Spherical, that is to say, round Angels, which consist of two circular lines drawn upon a Spherical superficies, which do crosse one another in some point, either rightly or obliquely: if rightly, then they make right angles, on each side of the point where they crosse, as the figure E sheweth; if obliquely, then they make sharp Angles, on the inside, and blunt Angles on the out side of the point, where they crosse, as the figure f, doth partly shew, for such Angles cannot be so well described in Plano, as upon the superficies of some Spherical body.





13 A

13 A Terme called in Latine terminus, is the bound or limit of any thing, as points are the bounds of lines, and lines the bounds of superficies, and superficies the bounds of a body, which is that which hath imaginatively, but not materially, both length, bredth, and depth, and if such body have many faces or sides, then it is bounded with many superficieses, as the figure *g*, made like a six-square Dy. But if such body bee round as a boule, Spheare or Globe, then it is bounded or covered with one superficies only, as the figure *h* doth shew.





14 A figure is that which is comprehended within one bound, or many bounds.

15 A Circle is a plain figure bounded with one circular line, which is called the circumference, unto the which as many right lines as are drawne from the point standing in the middest, are all equall one to the other, that is to say, one is as long as another, as the figure I here doth shew.



I

Circumference.

16 And the middle point of a Circle is called the Center, as the point *a*, in the figure I.

17 The Diameter of the Circle, is a right line passing thorow the Center, from one side of the Circumference to the other, which divideth the Circle into two equall parts, as the line b c.



18 A Semi-circle is a figure contayned within the Diameter and halfe the Circumference of a Circle, as the figure c d e.



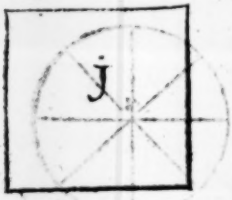


19 The portion of a Circle is a part of a Circle, greater or lesser than the Semicircle, as the figures *f* and *g* do shew, the right line in eyther of which figures is called in Latine chorda, in English the string, and the circular line in Latine is called arcus, in English the bow, but the Diameter is alwayes the greatest chord in a Circle.



20 Right-lined figures, are those which are bounded with right lines.

21 Triangles or three chorded figures are those which are bounded with three right lines, as the figure *h*.



22 Foure square figures, are those which are bounded with foure right lines, as the figure I.



23 Many square figures are those which are bounded with more right lines than foure, as K.



24 Of Triangles or three-cornerd figures, there be six kinds, whereof the first is called equilater, having three equall sides, and three equall angles, as A.



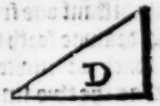
25 The second is called Isosceles, having but two equall sides and angles, as B.

26 The third is called Scalenos, having no side equall one with the other, but one shorter

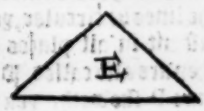
shorter or longer than another, as C.



27 The fourth is called Orthogonius, having one right angle, as D.



28 The fifth angle is called Ambligonium, because it hath one blunt angle, as E.



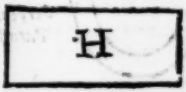
29 The sixth is called Oxigonius, because it hath three sharp angles, but not equall sides, as F.



30 Of foure square figures there is one just foure square, having foure equal sides, and is right angled, as G.



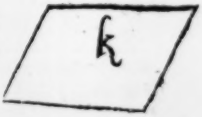
31 Another is called a long square which is right angled, but not having foure equall sides, as H.



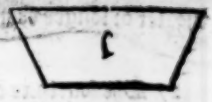
32 There is another called Rombus, that is to say, a Turbut in shape like to a Diamant which hath foure equal sides, but is not right angled, as I.



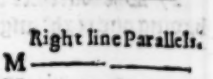
33 There is another called Romboides, which though it hath sides and angles, one right against another, yet hath it neyther foure equall sides, nor yet is right angled, as K.



34 All other kinds of foure squares are called trapezia, as L, and such like.



35 Parallels are two right lines equally distant one from another, which being drawne forth infinitely, would never touch or meete one another in any part, as the two lines M N. And though the lines be circular, yet if they be equally distant in all places one from another, they are also called Parallels, as the figure P sheweth, yea though the lines be winding in and out as Serpents, if they be equally distant in all places one from another, they are Parallels as well as if they were right lines, as the figure Q sheweth.







THE

THE FIRST PART OF THE SPHEARE.

CHAP. I.

Of Cosmography, what it is, and what kinds of Sciences it comprehendeth, and who were first inventers thereof.

WHat is Cosmography?

Cosmography is the description of the whole world, that is to say, of heaven and earth, and all that is contained therein.

What speciall kinds of knowledge are comprehended under this Science?

These 4, Astronomy, Astrology, Geography, & Chorography.

What is Astronomy?

Astronomy is a Science, which considereth and describeth the magnitudes and motions of the celestiall or superiour bodyes.

Which call you superiour bodyes?

The Spheares or Heavens, and the stars as well fixed as movable, which we shal define hereafter in their proper places.

What is Astrology?

It is a Science, which by considering the motions, aspects, and influences of the starres, doth foresee and prognosticate things to come.

What is Geography?

It is a knowledge teaching to describe the whole earth, and all the places contained therein, whereby universall Maps and Cards of the earth and sea are made.

What is Chorography?

It is the description of some particular place, or Region, Ile, City, or such like portion of the earth severed by it selfe from the rest.

Who were first inventers of these Sciences?

Some say that Atlas was the first inventer, whom the Poets faine to beare up the heavens with his shoulders, having his head placed in the North Pole, and his fæt in the South Pole, and his right hand bearing the East part, and his left hand the West part of the world. Albeit that some apply this fiction of the Poets to an high mountaine in Africa called Atlas, which for his great heigth surmounting the clouds, is said to beare up the skies. But some say that Adam our first Parent, was the first inventer thereof: and some others affirme that Abraham was the first inventer thereof. But whosoever was the first inventer, it well appeareth by Ptolomey his booke, called Almagesti, that he hath bæne no small furtherer thereof, and since his time in these later dayes Georgius Purbacchius, Ioannes de Monte Regio, Copernicus, and divers others have learnedly treated thereof. But leaving to speak of the first inventers, or of the furtherers of these Sciences, I will speake of the shape, capacity, and unity of the world. And because the shape thereof is likened to a round body called a Spheare, I will first define what a Spheare is.

Chap. II.

The definition of a Spheare, and of the unity, roundesse, and capacity of the world: also of the Poles and Axletree thereof.

What is a Spheare?

A Spheare is a round body, contained or covered with one only superficies or upper face, in the midst of which body is a point or pricke, called the Center, from which all right lines being drawne to any part of the superficies or upper part therof, are of equall length, as you may perceive by this figure here following, the Center whereof is marked with the letter A.

And



And this Spheare before defined representeth the frame of the whole world, containing all things, and is contayned of none.

How prove you that there is but one world?

By the authority of Aristotle, who saith, that if there were any other world out of this, then the earth of that world would move towards the Center of this world, which cannot be, unlesse it should first ascend from his owne Center to the superficies or upperface of the same, which is against nature, for every heavy thing naturally tendeth downward, and every light thing upward, which common experience sheweth: for a stone being cast upwards, will fall downwards, and the flame of a Candle being turned downward, will flie upward.

How prove you the frame of the world to be round?

By three reasons. First, by comparison, for the likenesse which it hath with the chiefe Idea or shape of Gods mind, which hath neither beginning nor ending, and therefore is compared to a Circle. Secondly, by aptnesse as well of moving as of containing, for if it were not round of shape, it should not be so apt to turne about as it continually doth, nor to containe so much as it doth, for the round figure is of greatest capacity and containeth most. Thirdly, necessity proveth it to be round, for if it were with angles or corners, it should not bee so apt to turne about, and in turning about, it should leave boyd and empty places, which nature abhorreth, for no place by nature can be without a body, nor a body without a place.

Whereupon is this Spheare or great round frame turned?

Upon two most firme and immovable hookes called in Latine Cardines mundi, and in Greeke Poli, derived of the verbe Polo, which is as much to say, as to turne. For as a dore turneth upon his hooks, so the world turneth upon his two Poles, whereof the one is fixed in the North, and the other in the South, and the North Pole is called in Latine Polus arcticus, and the South Pole is called Antarcticus, thorow which Poles

from the one to the other passeth a right imaginative line, called of the Astronomers the Axletree of the world, about the which the world continually turneth like a Cart-wheele, which you may see lively expressed in a materiall Spheare made for the purpose, for in Plano it cannot be so well described.

Chap. III.

Of the division of the world, and of the two essentiall parts thereof, and what things each part containeth.

How is the world divided?

Most writers do make a two-fold division thereof, that is, according to substance, and according to accidents, which accidents because they are none other thing, but points, lines, and Circles, and so incident and necessarily belonging (by position though not by nature) to the substantiall parts, as the one cannot be described without the other, neither the subiect without the accidents, nor the accidents without their subiects, I will therefore make but one division of the world, dividing the same into two essentiall parts, that is, the celestiall part, and the elementall part, in the description of which parts, it shall also plainly appeare what those lines and Circles be, and to what end they serve.

What doth the celestiall part containe?

The eleven Heavens and Spheares.

Make you no difference betwixt these Spheares, and the great Spheare which you last defined to be covered with one superficies, or upper face?

Yes verily, for these have two superficies or upper faces, that is, the Conver and Concave.

Which call you Convex? and which Concave?

The Conver is the outermost upper face of any thing that is round, and therewith hollow, as of an oven or vault, and the

the Concave is the innermost or hollow superficies of the said oven or vault, or of any such like round body having concavity or hollownesse.

Which be those eleven Spheares, or Heavens, whereof you did last speak.

In ascending orderly upwards from the Elements they bee these: The first is the Spheare of the Moone. The second, the Spheare of Mercury. The third, the Spheare of Venus. The fourth, the Spheare of the Sunne. The fift, the Spheare of Mars. The sixt, the Spheare of Iupiter. The seventh, the Spheare of Saturne. The eighth, the Spheare of the fixed stars, commonly called the firmament. The ninth is called the second movable or Christal heaven. The tenth is called the first movable. And the eleventh is called the Imperiall heaven, where God and his Angels are said to dwell.

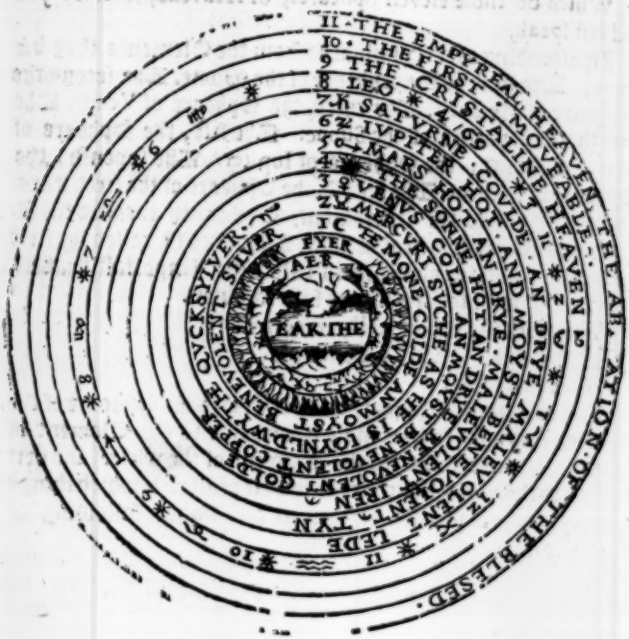
What doth the Elementall part containe?

It containeth the foure Elements.

Which be those?

The Element of the fire, which is next to the Spheare of the Moone, and next to that more downward is the Element of the ayre, and next to that is the Element of the water, and next to that is the earth, which is the lowest of all. All which things you may see here plainly set forth in this figure following on the other side.

A figure of the whole world, wherein are set forth the two essentiall parts before mentioned, that is to say, the eleven heavens and the foure Elements.



Chap. IIII.

A demonstration to prove the plurality of the heavens.

How is it to be proved that there is such multiplicity of heavens, fith to the eye it seemeth one whole body?

If there were not divers heavens and divers motions, there should neither be generation nor corruption of any thing; for all things then should bee as one

one, and ever in one estate. But besides that reason men have found out by experience in observing the divers rising and setting of divers starres called the Planets, that every such Planet hath a severall Spheare or heaven by it selfe, for otherwise they should continually keepe the places as the fixed starres do, which do move altogether according to the moving of the eighth heaven wherein they are placed.

I grant that there may be divers heavens or Spheares. But how prove you that there be ten movable heavens, besides the Imperiall heaven before mentioned, and specially sith of the old writers, some affirme that there be but nine, and some have said that there be no more than eight?

The later writers have found by good observation (as they say) that the firmament or eighth heaven hath three severall motions wherewith it is moved and turned about, which could not be, unlesse there were two movable heavens higher than that, as shall be declared when we come to shew the three-fold motion of the said eighth heaven. For here I minde briefly to describe unto you all the heavens, beginning at the highest, and so proceed to the lowest.

Chap. V.

Of the highest Spheare or heaven, called the Imperiall heaven.

The Imperiall heaven (as our ancient Divines affirme) is immovable, and being created by God the first day that he began the first creation of the world, was by him immediatly replenished with his Ministers the holy Angels, and this heaven being the foundation of the world, is most fine and pure in substance, most round of shape, most great in quantity, most cleare in quality, and most high in place, where God and his Angels are said to dwell.

Chap.

Chap. VI.

Of the tenth Spheare or Heaven, called in Latine, Primum mobile, *that is, the first movable, and what motion it hath.*

THis Heaven is also of a most pure and cleare substance, and without Starres, and it continually mobeth with an equal gate from East to West, making his revolution in 24 houres, which kind of moving is otherwise called the diurnall or daily moving, and by reason of the swiftnesse thereof, it violently carrieth and turneth about all the other Heavens that are beneath it from East to West, in the selfesame space of 24 houres, whether they will or not, so as they are forced to make their owne proper revolutions, which is contrary from West to East every one in longer or shorter time, according as they be farre or neare placed to the same: yet some writers do not admit any violence in the Heavens, but that every Heaven hath his proper and naturall moving without any violence.

I doe not well understand by what reason the first movable should have such force over the rest.

For your better understanding how this may be, suppose that you turne with your hand from East to West a Grind-stone, or some other turning wheele, whereon is placed a Flie or some other creeping worme, which commeth towards you from West to East, and you shall easily conceive that by your swift turning of the wheele, you shall turne about the said Flie or Worme many times contrary to her owne course, whether shee will or not, before she can get about the said Stone or Wheele.

That is true, proceed therefore to the rest, and tell the nature and moving of the ninth Heaven.

Chap.

Chap. VIII.

Of the ninth heaven, what motions and names it hath, and whether there be any waters above the firmament or not.

THe ninth heaven is alſo cleare of ſubſtance, and without ſtarres, having two mobings, the one from Eaſt to Weſt upon the Poles of the world accoꝛding to the daily moving of the firſt mouable, & the other from Weſt to Eaſt upon his owne Poles accoꝛding to the ſucceſſion of the Signes of the Zodiaque, which is in the firſt mouable, turning ſo ſlowly about as it maketh but one degrée in 100 yæres, and accompliſheth his full revolution in 36000 yæres, oꝛ as Alphonſus ſaith in 49000 yæres.

Is there then in the firſt mouable any Zodiaque, that is to ſay, a broad Circle carrying the twelve Signes, and yet no ſtarres?

Yea: though there be no ſtars, yet many ſuperſtitious fooles do imagine that there be divers Characters and liniaments not to be ſeene but with a moſt ſharp and ſubtill ſight; by vertue of which Characters and fained conſtellations they imagine that they can woꝛke wonders and ſtrange effects, enough to deceive themſelves and others too.

What is the cauſe that the ninth heaven is ſo long in making his proper revolution?

Becauſe, as I ſaid even now, this heaven is placed next to the firſt mouable, which carrieth him about contrary to his owne courſe with ſuch violence as he cannot make his owne proper revolution ſo ſoone as the other heavens which are placed further off.

If the ninth heaven be ſo long in making his courſe, it will never be compleat whileſt the woꝛld laſteth, for the whole age of the world according to ſome, is but 6000 yeeres.

Yet Plato was of another opinion, and therefoꝛe this revolution was called magnus annus Platonis, that is to ſay, the great:

great yeare of Plato, because he affirmed that when this revolution was once compleat, all things should be in the same estate wherin they were at the first, and that he should then stand reading to his schollers in the self-same chayre wherin he stood at that present: which fond opinion S. Augustine confuteth in his twelfth book de Civitate Dei, speaking in this manner, God forbid (saith he) that we should credit those things, for Christ died once for our sinnes, and being risen againe from the dead, he is no more to die, neyther can death have any more power over him, by vertue of whose resurrection, we also that beleeve shall rise againe, and dwell with God for ever.

By what name is this ninth heaven called?

Some do call it the Christaline heaven, because of the clearenesse therof, and some the watry heaven, because the Scripture affirmeth that there bee waters above the firmament, as we read in Gen. chap. 1. Let the firmament be made, and divide the the waters from waters. Againe we read in the Psalmes, all ye waters that be above the firmament, blesse ye the Lord.

The naturall Philosophers allow no waters to dwell above the firmament.

That is true, yet notwithstanding if the holy Scriptures do manifestly affirme, that there be waters above the firmament, it behoveth a Christian to beleeve it: but question perhaps may be moved, what manner of waters they are that are above the firmament, whether such as breed raine, or whether they are onely to be referred to the Christaline heaven, because it is of a watry substance, and therefore of some is called the watry heaven, affirming it to bee placed next to the primum mobile, or first movable, to the intent that with the coldnesse thereof it might asswage and represse the extreame heat of the same primum mobile, which otherwise (as some affirme) with his swift and violent moving, would set all the heavens on fire, and yet no raine is bred therein, for the great raine that drowned the world in Noahs time, did not fall from above the firmament, but from the ayre, which in the holy Scriptures is many times signified by this Latine word Cœlum, that is to say, Heaven, as when the Scripture saith, the flood-gates of heaven were

were opened, is as much to say, as the flood-gates of the ayre were opened, &c. But leaving this question, let us proceed to the eighth heaven.

Chap. VIII.

Of the 8 heaven: what motions it hath, and what Circles are imagined by the Astronomers to be in that heaven, and to what use and purpose they serve: Also in what time every one of the seven Planets maketh his revolution, and of what thicknesse their Spheares be.

The eighth heaven, otherwise called the firmament, is a most glorious heaven, adorned with all the fixed starres.

Why are they called fixed?

Because they are fastned in this heaven, like knots in a knotty board, having no moving of themselves, but are moved according to the moving of this eighth Spheare, or heaven, wherein they are fixed.

How manifold is the moving of this heaven?

The moving of this heaven (as hath bin said before) is threefold. For first it turneth about every day from East to West in 24 houres, according to the moving of the first movable, otherwise called the diurnall moving. Secondly, it moveth from West to East, according to the moving of the ninth heaven, which maketh but one degree in an hundred yeares, and this moving is called motus augium Stellarum fixarum.

What are Auges?

They be certaine imagined points in the heaven, notifying the furthest distance of any Orbe or Spheare from the Center of the world: Thirdly, it moveth sometime towards the South, and sometimes towards the North, by vertue of his owne proper moving, called in Latine motus trepidationis, that is to say, the trembling moving, whereby it is moved upon two little Circles, the Poles whereof are in the beginning of that Aries and that Libra, which are imagined to be in the ninth heaven,

heaven, the Semidiameter of which little Circle is foure degrees, 18′, and 43″, and maketh his whole revolution in 7000 yeares, and this moving is otherwise called motus accessus & recessus, that is to say the moving of approaching and retiring, and is only proper to the eight Spheare: for every naturall body by order of nature, can have but one proper moving, and by reason of this moving, the fired starres be not alwayes equally distant from the immovable Poles of the tenth Spheare, nor alwayes under the Ecliptique of the said tenth Spheare, but ostentimes cleane without it. For the fired stars are in equall times equally distant from the beginning of that Aries and Libra, which are imagined to be in the tenth heaven, but they seeme to move sometime towards the East, and sometimes towards the West, now more swiftly, and now more slowly. For Ptolomy in his time found them to be moved in 100 yeares one degree. And the later observers have found them when they be in their swift motion to be moved one degree in 36 yeares, all which three movings are easie (as some affirme) to be demonstrated by one instrument made of purpose, shewing every severall moving of this heaven by it selfe, but such demonstrations, as some others think, be not altogether necessary conclusions: for it may be that the daily moving is common to the whole frame, and that the moving of the Auges of the fired starres, is proper to the eighth Spheare having some other mover, and the like objection may be made touching the trembling moving, called motus crepidationis. But now you have to understand, that for the better describing, dividing, and measuring of this heaven, and all the apparances thereof, the Astronomers with the pensill of imagination, or rather of most necessary invention, do (as it were) trace the same with certaine Circles both greater and lesser, whereof we shall speake as soone as we have briefly shewed the moving of the rest of the heavens, contayned in the celestiall part of the world, in such order as they follow one another. For next to the firmament is the heaven of Saturne, which maketh his revolution from West to East in thirty yeares, next to him is the heaven of Iupiter, who maketh his

revolution

revolution from West to East in twelue yeres, next to him is the Heaven of Mars, which maketh his revolution also from West to East in two yeres, next to him is the Heaven of the Sun, which maketh his revolution from West to East in 365 dayes and sir houres lacking certaine minutes, next to him is the Heaven of Venus, which maketh her revolution from West to East in like time as doth the Sunne, next to Venus is the Heaven of Mercury, which maketh his revolution from West to East in the like space that Venus doth: And next to Mercury is the Heaven of the Moon, which maketh her revolution from West to East in 28 dayes and certaine minutes. Thus hauing briefly described the eleuen Heauens, I will now treat of the circles that are imagined (as I said before) by the Astronomers to be in the eighth Heaven or firmament, to the intent that the measures and distances of the starres, images, signes, and other apparances therein contayned, might be the better demonstrated.

Before you deale with these Circles, I would gladly vnderstand some reason why all these seuerall Heauens seem to the eye but as one entire body.

That is, because they are all cleere and transparant like fine Birall Glasse, or Chrystall, thorow the which the light doth easily pierce, though there were neuer so many Coates of such cleere substance, couering one another like the skales of an Onion, for so the Heauens do cober and enclose one another, and euery one is of an exceeding great thicknesse.

Why, how thick is euery such Heaven?

The Heaven of the Moon contayneth in thicknesse ——— 105|222.$\frac{8}{11}$ miles.

The Heaven of Mercury contayneth ——— 253372$\frac{8}{11}$

The Heaven of Venus, ——— 3274494$\frac{8}{11}$

The Heaven of Sol, ——— 343996.$\frac{4}{11}$

The Heaven of Mars, ——— 26|308|800

The Heaven of Iupiter, ——— 1899654.$\frac{8}{11}$

The Heaven of Saturn, ——— 19604454.$\frac{4}{11}$

What need haue the Heauens to be so thick?

Because otherwise they could not contayn each one his star

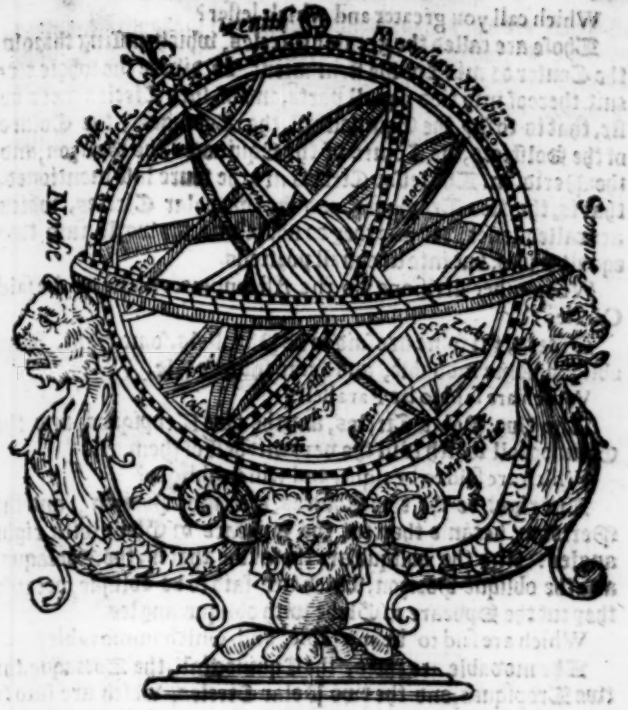
or starres, for there is no fixed star so little, but that it is farre greater in compasse than the earth, neither is there any wandring starre, but that it is bigger than the earth, the Moone, Venus, and Mercury excepted.

For the Sunne containeth the earth	166 times.
Saturn containeth it	95 times.
Iupiter containeth it	91 times.
Mars containeth it	2 times.
Venus is lesser than the earth	39 times.
Mercury is least of all, and is contayned of the earth	3143 times.

You haue well satisfied me touching these matters, and therefore now proceed with the Circles if you think so good.

Before that I describe unto you the circles whereof a Spheare is made, or declare the uses thereof, I think it not amisse here to set downe the shape of a Spheare, together with the names of every Circle written upon the same, to the intent that you may be acquainted with all the parts of a Spheare before you come to use the same: which shape or figure, was first drawne by Master Blagrave, and is set downe in his Booke called the Mathematicall Iewell.

CHAP.



CHAP. IX.

Of the Circles whereof a materiall Spheare consisteth, and of their divers divisions.

OF Circles which are imagined to be in the Firmament, and whereof a Spheare representing the shape of the World is commonly made, bee in all ten, that is to say, the Equinoctiall, the Zodiaque, the two Colures, the Horizon, the Meridian, the two Tropiques, and the two Polar Circles: of which some be greater, and some lesser.

Which call you greater and which lesser?

Those are called the greater Circles, which passing through the Center or midst of the firmament, do divide the whole circuit thereof into two equall parts, and of such Circles there be sir, that is to say, the Equinoctiall, the Zodiaque, the Colure of the Solstices, the Colure of the Equinoxes, the Horizon, and the Meridian. The lesser Circles are the foure last mentioned, that is, the two Tropiques, and the two polar Circles, which are called lesser, because they do not divide the world into two equall parts, but into unequall portions.

What other divisions do the Astronomers make of the said Circles?

Divers, for some are said to be Parallels, some right, some oblique, some movable, and some immovable.

Which are said to be Parallels?

The two Polar Circles, and the two Tropiques, and the Equinoctiall which is in the very middest of them all.

Which are said to be right, and which oblique?

The right be the two Colures, the right Horizon, and the Meridian, because they cut the Spheare or Globe with right angles: And the oblique are these two, that is, the Zodiaque, and the oblique Horizon, which are said to be oblique, because they cut the Spheare or Globe with oblique angles.

Which are said to be movable, and which immovable?

The movable are these, the Equinoctiall, the Zodiaque, the two Tropiques, and the two Polar Circles, which are said to be movable, because they continually move with the firmament, and are like in all places. And these also having respect to a materiall Speare, are said to bee intrinsicall or inward. The immovable are these two, that is, the Horizon, and the Meridian, which are said to bee immovable, because in the turning of the Spheare they remaine unmoved, for though we change both Meridian and Horizon by going from one habitation to another upon the Earth, yet every place hath still his owne Meridian and Horizon, which do remaine immovable, and these two circles having respect to a materiall Spheare, are said to be extrinsicall or outward, because they do include on the outside

outside all the other Circles of a Materiall Spheare. Thus having set downe the divisions of the said Circles, I will now describe them all in order, and shew to what uses they serve, beginning first with the great Circles, and so proceed to the lesser, and first I will speake of the Equinoctiall.

Chap. X.

Of the Equinoctiall line, why it is so called, and of the divers uses thereof.

What is the Equinoctiall?

The Equinoctiall is a great Circle, which being in every part equally distant from the two Poles of the world, divideth the Spheare in the very middest thereof into two equall parts, and therefore it is called of some, the girdle of the world.

Wherefore is it called by the name of the Equinoctiall?

Because that when the Sunne toucheth this Circle, which is twice in the yeare, the day and night is of equall length throughout the world.

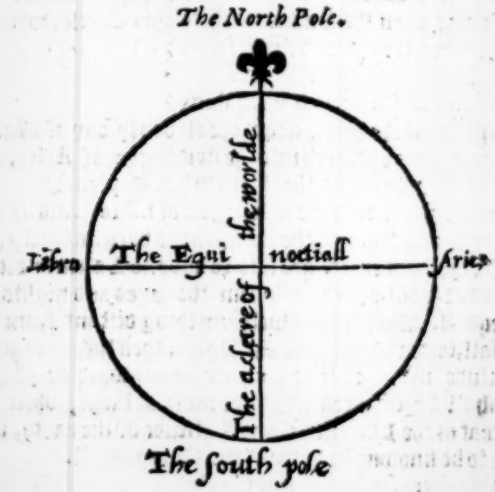
At what time of the yeere is it Equinox?

In the spring of the yeare, about the eleventh day of March, when as the Sunne entereth into the first degree of Aries, and againe in Autumne about the thirteenth of September, when as the Sunne entreth into the first degree of Libra. And by reason that this Circle divideth the world in the very middest, those that dwell right under it, are said to have no Latitude either Northward or Southward, to whom the dayes and nights are alwayes equall. But if they dwell any thing distant from the Equinoctiall, towards either of the Poles, then they are said to have Latitude more or lesse, either Southward or Northward, as shall be declared hereafter more at large, when we come to treat of the Longitude and Latitude of the earth, both which are to be knowne by helpe of the Equinoctiall.

To what other uses serveth this Circle?

This Circle hath many most necessary uses, for first it sheweth the daily moving of the first movable, which maketh his revolution in 24 houres, which houres are equall, and are to be measured by the degrées of the Equinoctiall, by allowing 15 degrées thereof to an houre. And therefore the degrees of the Equinoctiall are commonly called in Latine of the Astronomers, tempora, of which degrees it containeth 360, which being divided by 15, do make 24 houres, which is a naturall day, containing both day and night: Moreover, it sheweth the declination of the fixed stars and their right ascentions, whereof we shall speake when we come to treat of the stars; and by his equall motion, all the inequalities of the Zodiaque, and of all the signes contained therein, are measured: and to be short, this Circle hath many other good uses not to be declared untill you have some knowledge of the rest of the other Circles hereafter described.

A figure shewing the Equinoctiall line, the two Poles, and Axeltree of the World.



CHAP.

Chap. XI.

Of the Zodiaque, why is it so called, and of the twelve signes therein contained: also of the Latitude, Longitude, and declination thereof.

What is the Zodiaque?

It is a broad, obliqu?, or slope Circle, having a circular line in the middest thereof, called the Ecliptique line, and divideth the Spheare into two equall parts, by crossing the Equinoctiall with oblique Angles in two points, that is, in the beginning of Aries, and in the beginning of Libra, so as the one halfe of this broad Circle declineth towards the North, and the other halfe towards the South: in which Circle many things are to bee considered, first the name, then what breadth it hath, and why it hath such breadth, and into what parts it is divided as well touching the breadth or Latitude, as circuit or Longitude thereof, also into how many parts the Firmament is divided by the spaces described in the Zodiaque, and appointed to the twelve Signes. Also how much it declineth from the Equinoctiall towards the South or North, and upon what Poles it turneth about, and why the line in the middest is called the Ecliptique line, and many other necessary points, which I mind here briefly to touch.

Why is this Circle named the Zodiaque?

It is named the Zodiaque either of this Greeke word zoe, which is as much to say, as life, because the Sunne being moved under this Circle, giveth life unto the inferiour bodies; or else of this Greeke word Zodion, which is as much to say, as a beast, because that twelve Images of Stars, otherwise called the twelve Signes, named by the names of certaine beasts, are formed in this Circle: and therefore the Latines do call this Circle, Signifer, because it beareth the twelve Signes.

How are these Signes called, and with what Characters are they marked?

Their names and Characters this Table here following doth shew, and also which be opposite one to another, as Aries to Libra, Taurus to Scorpio, and so forth.

The six Northerne signes.		The six Southerne signes.	
Aries	♈	Libra	♎
Taurus	♉	Scorpio	♏
Gemini	♊	Sagittarius	♐
Cancer	♋	Capricornus	♑
Leo	♌	Aquarius	♒
Virgo	♍	Pisces	♓

Of which signes the first six on the left hand are called the Northern signes, because they are contained in that halfe of the Zodiaque, which declineth towards the North. And the other six on the right hand being right opposite to the first six, are called the Southerne signes, because they are contained in the other halfe of the Zodiaque, declining towards the South: and against every signe is set his proper Character.

What divisions do Astronomers make of the twelve signes?

Divers, as followeth: for some are said to be ascendent, and some descendent.

Ascendent are those that rise from the South towards our Zenith, tending Northward, which be these, Capricornus, Aquarius, Pisces, Aries, Taurus, and Gemini.

The Descendent are these, Cancer, Leo, Virgo, Libra, Scorpio, and Sagittarius.

Againe, some are said to be vernall, as Aries, Taurus, and Gemini.

Some Æstivall, as Cancer, Leo, Virgo.

Some Autumnall, as Libra, Scorpio, and Sagittarius.

And some Hyemall or Brumall, as Capricornus, Aquarius, and Pisces, signifying the foure seasons of the yeare, that is to say, the Spring, Summer, Autumne, and Winter.

And some do make divers other divisions, which because they appertaine to Astrologie rather than to the Treatise of a Spheare, I willingly omit them.

Now

Now tell what bredth the Zodiaque hath, and why it is imagined to have such bredth?

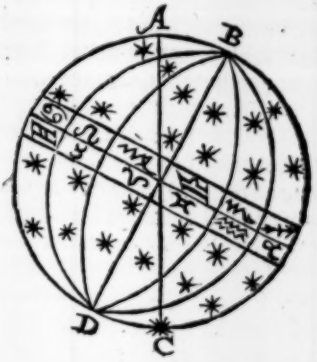
It hath (according to the ancient writers) twelve degrées in bredth, that is to say, six degrées on the one side of the Ecliptique line, and six degrées on the other side of the Ecliptique line, but according to the moderne writers, it hath sixténe degrées in bredth, that is, eight degrées on each side of the Ecliptique line, which bredth was necessarily imagined, first to the intent that by the measures and degrées thereof it might bee known, how much the Planets (otherwise called the wandring starres, whose course is to passe continually under this broad Circle) do wander at any time on either side of the Ecliptique line, for they all wander, but some more, some lesse, the Sunne only excepted, which never swarveth from that line, but alwayes goeth right under the same, and therefore the said line is called of some writers the way of the Sunne: And secondly, it hath such bredth, to the intent it may containe within the same the twelve signes aforesaid, by meanes of which signes the whole circuit or Longitude of the said Circle is divided into twelve equall parts, and every such part is divided into thirty degrées, and every degrée into sixty minutes, and every minute into sixty seconds, &c. so as the whole Longitude thereof containeth 360 degrées, according unto which division, all the rest of the Circles both greater and lesser described in the Spheare, are made to containe the like number of degrées, and every halfe Circle to containe 180 degrées, and every quarter of a Circle to containe ninety degrées, and by this division as well of the bredth, as of the length of the Zodiaque, it appearth that every one of the twelve signes hath thirty degrée in length, and twelve degrées in bredth, and thereof the Planets, Stars, and all other Celestiall bodies are said to have both Longitude and Latitude, the Sunne only excepted.

How is such Longitude and Latitude to be understood?

The Longitude of any Planet or Starre is to be counted in the Ecliptique line containing in circuit 360 degrées, reckoning from the first point of Aries, and so to Taurus, Gemini, and Cancer, and so forth according to the succession of the

signes,

signes untill you come againe unto the first point of Aries, at which point such Longitude both endeth and beginneth. The Latitude is counted from the said Ecliptique line towards any of the Poles of the Zodiaque. And hereof loke how many degrees any fixed Star or Planet is distant from the Ecliptique line towards any of the said Poles, so much Latitude it is said to have either Northerne or Southerne: moreover, by this division of the signes the whole firmament is divided into 12 parts by reason of the six Circles called the Circles of position, imagined to passe thorow the Poles of the Zodiaque, and also thorow the beginning of every signe, whereby we know under what signe every starre is situated though it bee cleane out of the Zodiaque, as this figure heere plainly sheweth, marked with these letters, A, B, C, D. A signifieth the North Pole of the world; B, the North Pole of the Zodiaque; C, the South Pole of the world; D, the South Pole of the Zodiaque.



Chap. XII.

How much the Zodiaque declineth from the Equinoctiall towards either of the Poles, and of the greatest declination of the Sunne, what it is at this present, and what it hath beene in time past.

You have to understand that the Zodiaque, or rather the Ecliptique line, declineth from the Equinoctiall towards either of the Poles, three degrees, 30', and that is said in these dayes to be the greatest declination of the Sunne, which declination is two-fold, that is North-

therne

therne and Southerne, for like as the Sunne entring into the first point of Aries, beginneth then to decline from the Equinoctiall Northward, to the quantity of 23 degrees, and 30′: so entring into the first point of Libra, he declineth againe from the Equinoctiall as much Southward. And note by the way, that by reason of his slow motion, when he is in the Northerne signes, he spendeth seven dayes, and $\frac{1}{7}$ of a day more in making his North declination than in making his South declination, because he is then in his swift motion, and the time hath beene that he hath spent above then dayes more in making his North declination, than in making his South declination: neither is the greatest declination of the Sunne in all ages of like quantitie. For in Ptolomies time it was 23 degrees, 51′, and 20″, ever since whose time it hath alwayes continually decreased untill this present, so as now the greatest declination is no more but 23 degrees, and 30′. And Copernicus maketh the declination of the Sunne in respect of quantitie to be two-fold, that is, greatest and least, affirming the greatest to be 23 degrees and 51′, and the least to be 23 degrees and 28′, as it is now counted, the difference whereof is 24′, and whilest the Ecliptique departeth from the Equinoctiall, and turneth againe towards the Equinoctiall, there do runne (as he saith) 3434 yeeres.

Chap. XIII.

How to know the quantitie of the Sunnes declination, be it Northward or Southward, every day throughout the yeere, as well by a Table as by helpe of the Spheare.

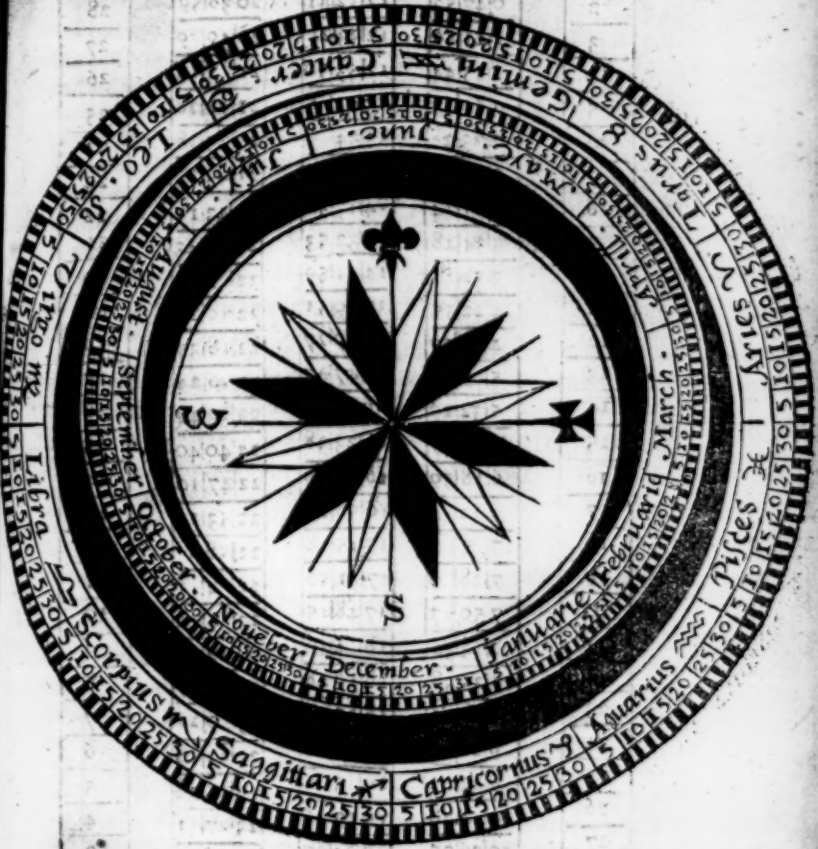
This is chiefly to bee knowne by Tables calculated of purpose, which Tables most commonly are either made to answer every day of the Month, or else to the degree of the signe wherein the Sunne is every day, which kind of Table is contained in lesser roome than the other: but to worke by such a Table, you must first know in what

what signe and degrée the Sunne is every day.

How is that to be done?

It is to be knowne most truly by the Ephemerides, or such like Table calculated of purpose, shewing not only the degrée of the signe, but also the very minute wherein the Sunne is every day, and for want of such a Table, you may without consideration of the minutes, know it by such an instrument or figure as this following, which consisteth of divers Circles, whereof the outermost containeth the degrées of the twelve signes, together with the names of the said signes, and the next the dayes of each month, together with the names of the said months, much like the back-side of an Astrolabe, in the Center or middest of which figure or instrument is a thred, which if you lay upon the day of the month which you seeke, it will straight direct you to the degrée of the signe wherein the Sunne is that day; as for example, if you would know in what signe and degrée the Sunne is the fourth of May, then by drawing the thred right upon the said day over and beyond the outermost Circle, you shall finde that it will fall right upon the 23 degrée of Taurus.

An Instrument to know thereby in what Signe and degree the Sunne is every day throughout the Yeere.



¶ Then having found the degree of the Sunne, you must resort therewith to this Table following, made for the declination of the Sunne.

A Table shewing the declination of the Sunne every day throughout the yeere.

Degrees of the signes.	♈ ♎ D. M. S.	♉ ♍ D. M. S.	♊ ♐ D. M. S.	Degrees of the signes.
1	0 23 57	18 51 48	20 25 57	29
2	0 47 53	12 12 41	20 38 59	28
3.	1 11 49	12 33 21	20 49 9	27
4	1 35 44	12 53 50	21 1 15	26
5	1 59 37	13 13 5	21 12 28	25
6	2 23 28	13 34 8	21 23 8	24
7	2 47 18	13 53 57	21 43 23	23
8	3 11 4	14 13 32	21 43 15	22
9	3 34 48	14 32 53	21 52 43	21
10	3 58 28	14 51 59	22 1 45	20
11	4 22 55	15 10 51	22 10 22	19
12	4 45 37	15 29 27	22 18 35	18
13	5 9 5	15 47 47	22 26 22	17
14	5 32 29	16 5 52	22 33 44	16
15	5 55 47	16 23 38	22 40 40	15
16	6 18 59	16 41 9	22 47 10	14
17	6 42 6	16 58 22	22 53 14	13
18	7 5 6	17 15 18	22 58 52	12
19	7 28 0	17 31 56	23 4 3	11
20	7 50 7	17 48 15	23 8 48	10
21	8 13 36	18 4 10	23 13 6	9
22	8 35 38	18 19 48	23 16 57	8
23	8 58 21	18 35 20	23 20 21	7
24	9 20 36	18 50 22	23 23 18	6
25	9 42 42	19 5 5	23 25 48	5
26	10 4 38	19 19 26	23 27 51	4
27	10 26 25	19 32 27	23 29 27	3
28	10 48 2	19 47 7	23 30 35	2
29	11 9 28	19 59 59	23 31 16	1
30	11 30 44	20 13 22	23 31 30	0
D.	D. M. S.	D. M. S.	D. M. S.	D.

The description and use of the Table.

THis Table consisteth of five Columns, whereof the first on the left hand, and the last on the right hand, do containe the degrées of the twelve signes of the Zodiaque, counting from one to thirty. And the three middle columns do containe the degrées, minutes, and seconds of declination, over the head of which three middle columnes, are set downe the Characters of these six opposite signes, Aries and Libra, Taurus and Scorpio, Gemini and Sagittarius, and at the foot of the said middle columnes are set downe the Characters of the other six opposite signes, that is, Virgo and Pisces, Leo and Aquarius, Cancer and Capricornus: for every two opposite signes, as well above as beneath, have like declination. The use of which Table is thus: First having found out the degrée of the Sunne by the Instrument before described, or rather by some true Ephemerides, you must seeke out the number of the said degrée, either in the first or last columne, according as the Character of the signe is placed. For if the signe or Character be above, then you must seeke for the said number in the first columne on the left hand, which numbers do descend from one to thirtie, but if the signe bee beneath, then you must find it out in the outermost columne on the right hand, the numbers whereof do ascend from one to thirty, and the common angle or square, standing right against the said number, will shew you the degrée, minutes, and seconds of the declination: As for example, having found by the former Instrument that the fourth day of May the Sun is in the 23 degrée of Taurus, I seeking the Character of Taurus to stand above, do seeke my foresaid number of 23 degrées in the first columne on the left hand, and in the common angle or square right against that number, and under the signe Taurus, I find the declination of the Sunne to bee 18 degrées, 35', and 20''. But this Table cannot serve allwayes: yea rather such Tables as are to be renewed, as our Astronomers say, every thirty yéeres. Also you may know the daily declination of the Sunne, by helpe of the materiall Spheare or Globe thus: having set the Spheare at your Latitude, bring the degrée of

the

the signe wherein the Sunne is that present day vnto the mouable Meridian, and staying it there, marke whether it falleth on the South side or on the North side of the Equinoctiall: for if it be in any of the Northerne signes, it will fall on the North side of the Equinoctiall, and if ♑ bee in any of the Southerne signes, it will fall on the South side of the Equinoctiall, and by counting the degrees vpon the Meridian, contained betwixt the degree of the Sunne and the Equinoctiall, you shall know what declination the Sunne hath that day, as for example, in the Latitude 52 in the yere 1590, the fift day of May, I finde the Sunne by the Ephemerides, to be in the 23 degree, and 48 of Taurus, which point I bring to the mouable Meridian and there staying it, I finde that point to be distant from the Equinoctiall Northward, eighteene degrees and certaine minutes, and so much of North Declination I conclude the Sun to have that day.

Chap. XIIII.

Vpon what Poles the Zodiaque turneth about, also of the Ecliptique line, and of the divers vses thereof.

THE Zodiaque turneth about vpon his owne proper Poles from West to East, whereof the one being placed in the Colure of the Solstices, towards the North, is distant from the Pole Arctique 23 degrees, and 30', and the other is placed in the said Colure towards the South, being of like distance from the Pole Antarctique, wherof the Astronomers have a generall Rule, affirming that the distance of the two Poles of the World, from the Poles of the Zodiaque, is alwayes equall to the greatest declination of the Sunne, which as hath beene said before, is 23 degrees, and 30', as you may plainly see by the Spheare. And note, that those two Poles are otherwise called the Poles of the Ecliptique, for in considering the declination of the Sunne or of the Zo-

diaque

diaque from the Equinoctiall, you must have respect only to the Ecliptique line, which is in the middest of the Zodiaque, and not to any other part of the Zodiaque. And as the Equinoctiall line sheweth the moving of the first movable, which is from East to West, so the Ecliptique line sheweth the moving of the second movable, which is from West to East, cleane contrary to the first movable, the causes whereof have beene before declared.

What other uses hath this Line more than you have already declared?

It hath divers, for in this Line or Circle are noted the degrees, wherewith any Star riseth or goeth downe, either rightly or obliquely, for all the appearances of the Heavens are chiefly referred to this Circle. Againe, by this Circle the chiefest distinctions and parts of time, as yeares, and monthes, are known, and also the foure Seasons of the Yeare, as Spring, Summer, Autumne, and Winter: Moreover, the obliquity of this Circle under which the Sunne continually walketh, is cause that the dayes both naturall and artificiall are unequall. Finally, this Circle doth shew the places and times of Eclipses both Solar and Lunar, from whence this Line taketh his name, of which Eclipses we minde here briefly to treat.

Chap. XV.

Of the Eclipses both Solar and Lunar, and of the head and tayle of the Dragon, with certayne Figures shewing the same.

What signifieth this word Eclipses?

It is as much to say, as to want light, and to bee darkened or hidden from our sight, as when the Sunne and Moone are both at one selfe-time right under the Equinoctiall Line, the one of those two lights most commonly is eclipsed and darkened: for there bee two Eclipses, the one of the Sun, and the other of the Moon, but sith that neither the Eclipse of the Sun or

of the Moon doth chance, but when they meet either in the head or tayle of the Dragon, I thinke it good to shew first what is meant by the head and tayle of the Dragon. The Dragon then signifieth none other thing but the intersection of two Circles, that is to say, of the Ecliptique and of the Circle that carrieth the Moon, called her Defferent, cutting one another in two points, whereof that intersection which is Westwards, when as the Moone goeth towards the North, is called the head, and that which is Eastwards, when the Moone goeth towards the South is called the tayle, marked with such Characters as you see in the figure following, and that part towards the South is called of some the belly of the Dragon. And note, that the Defferent of the Moone is at no time distant from the Ecliptique above five degrees at the most.

The figure of the Dragon.



This being presupposed, I will speake first of the Eclipse of the Moone, and then of the Sunne, both which may be eclipsed either totally or in part.

When is the Moone said to be totally eclipsed?

When the Sun and Moone are opposite one to the other diametrally.

metrally, and the Earth is in the very middest betwéne them both: for the body of the Earth being thick and not transparent, casting his shadow to that point which is opposite to the place of the Sun, will not suffer the Moon to receive any light from the Sunne, from whom she alwayes borroweth her light.

At what time is the Moone said to be diametrally opposite to the Sunne?

When a right line drawne from the Center of the Sunne, to the Center of the Moon, passeth thorow the Center of the earth: and note, that every time that she is at the full, she is opposite to the Sunne, and yet the Earth is not at every such full diametrally betwirt her and the Sunne, for then she should be eclipsed at every full, which indeed cannot be, but when she is either in the head or tayle of the Dragon,

When is the Moone sayd to be eclipsed in part?

When the Sunne, the Earth, and the Moone be met in one selfe diametrall line, but the Moone is declining either on the one side or on the other, as you may plainly see by this figure following.

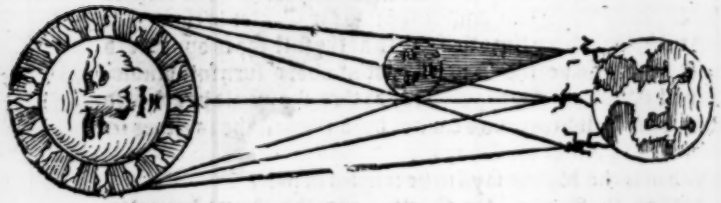


But note that the Eclipses of the Moone may be universall, because the Earth is farre bigger than the Moone, and therfore able to shadow her whole body.

When is the Sunne sayd to be eclipsed?

When the Moone is betwirt the Sun and the Earth, which chanceth in a conjunction, and yet not in every conjunction, but when it falleth either in the head or tayle of the Dragon, which

may chance, as I said before, either totally or in part: totally I say, in respect of those parts of the earth whereon the shadow directly falleth. For sith the Moone is far lesser than the Earth, she cannot shadow all the Earth, and therefore the Eclipse of the Sunne cannot be universall, but yet to some parts of the Earth totally, and to some partly, and to other some nothing at all, as you may plainly see by this figure following.



Yet all the Histories do affirme that the Eclipse of the Sunne was universall at the death of Christ.

Yea, that was miraculous, and also it was then at the full of the Moone, which was also as miraculous: and therefore Dionysius a Senator of Athens, beholding that Eclipse, cryed out, saying these words, Either God this day suffereth, or else the World must needs perish for ever: which Dionysius was the first that converted the Frenchmen to the Faith of Christ, doing there great Miracles, in honour of whom was erected the rich Abbey of Saint Denis, not far from Paris, whereas the Kings and Princes of France were wont to be buried.

How is it to be proved that the Eclipse at Christ his death, was at the full of the Moone?

As well by ancient History, as by Saint Augustine, who saith that the Iewes were wont to keep their feast of Passeover (at which time Christ suffered) alway at the full of the Moone.

If the Sunne and Moone be eclipsed but in part, how are such parts to be accounted?

By the parts of the Diameter of the bodies of these two Planets, for the Astronomers do divide the Diameter as well of the Sunne, as of the Moone into 12, and some into 24 parts, which

which they call points, and therefore are wont to say, that the Sunne or Moone are darkned or eclipsed seven points, eight points, nine points, &c.

Chap. XVI.

Of the two Colures, and why they are so named, and whereto they serve: also of the foure Cardinall points, that is, of the two Equinoctiall, and the two Solstitiall points, and of the entrance of the Sun into any of those points, or into any other Signe.

What be Colures?

They be great mouable Circles passing thorow both the Poles of the World, which the Astronomers do otherwise call circles of declination, whereof they make 180, which are halfe so many as there be degrees in the Equinoctiall, applying them to divers uses not needfull here to be rehearsed: for sith that there are but 2 Colures accustomably set down in the Spheare, without the which a materiall Spheare cannot be made, I minde here therefore only to treat of them.

Shew first what this name Colure signifieth?

This word Colure being compounded of Colos and Oura, is as much to say, as unperfect or maymed, the tayle being cut off, because none of those circles are ever seen whole above our Horizon, but part thereof, for some part is alwayes seen, and some part is alwayes hidden, as that part which is above the Horizon, and nigh unto the Pole, is alwayes seen, because it never goeth down under the Horizon: likewise that which is nigh unto the South Pole is alwayes hidden from us, because it never riseth above our Horizon, as by turning the Spheare about, you may easily perceive the same.

Which be those Colures that are commonly set down in the Spheare, and how are they named?

They are two great movable Circles, passing thorow the Poles of the World, crossing one another in the said Poles with right Spherical Angles, by meanes whereof they divide the whole Spheare into foure equall parts, of which two Colures, the one is called the Colure of the Equinoxes, and the other the Colure of the Solstices.

Describe these two Circles, and shew why they are so named.

The Colure of the Equinoxes is so called, because it cutteth the Zodiaque in the beginning of Aries, which is called the vernall Equinox: and also in the beginning of Libra, which is called the Autumnall Equinox, at which two times the dayes and nights be equall, as hath bene said before when wee did speake of the Equinoctiall Circle, and this Circle divideth the Ecliptique into two halfes, the one Septentrionall, and the other Meridionall, and thereby sheweth the Signes wherein the Sunne maketh the dayes longer and shorter than the nights: for whilest he is in the six Northern Signes, he maketh the dayes with us longer than the nights: and when hee is in the six Southern Signes, hee maketh the nights longer than the dayes. Now you have to understand that the Colure of the Solstice, is so called, because it cutteth the Zodiaque in the two Solstitiall points, that is to say, in the beginning of Cancer, and in the beginning of Capricorne, as you may see in beholding and turning the Spheare about with your hand.

Why are these two points called Solstitiall?

They take their name of these two Latine words Sol and Statio, that is to say, the Sunne, and standing, for when the Sunne is in any of these two points, he seemeth to stand still, or at the least moveth so little, as his proper moving from West to East cannot be easily perceived, during the space of twelve dayes. And you have to note, that when the Sunne entreth into the first degrée of Cancer, which is about the twelfth of June, then he is at the highest, and the dayes be at the longest, and therefore it is called the Summer Solstice. Againe, when he entreth into the first degrée of Capricorne, which is about the twelfth of December, then the Sunne is at the lowest, and the nights are the longest, and therefore it is called the Win-

ter

ter Solstice. And in this Colure there are set downe the two Poles of the Ecliptique line, being distant from the Poles of the world three and twenty degrees and 30'. Moreover, on this Colure is measured the greatest declination of the Sunne, which is alwayes equall to the distance of the Pole of the Ecliptique, from the Pole of the world, as hath bene said before. And you have to note, that the foure former points, that is to say, the two Equinoctes, and the two Solstices, are commonly called the foure cardinall or principall points, and of some they are called the foure points of Change, signifying the foure beginnings of the foure divers Seasons of the yere: for betwixt the beginning of Aries, and the beginning of Cancer, is contained the Spring-time: and betwixt the beginning of Cancer and the beginning of Libra is the Summer time: and from the beginning of Libra to the beginning of Capricorne, is the time called Autumne, or fall of the Leafe: and from the beginning of Capricorne to the beginning of Aries, is contayned the Winter season, albeit the Sunne entreth not into any of these Signes alwayes at one selfe day or time of the yere: for at Christ his Incarnation, the Sunne entred into Aries the five and twentieth day of March, and into Cancer the foure and twentieth of Iune, and into Libra the seven and twentieth of September, and into Capricorne the five and twentieth of December, which was then the shortest day in the yere, and the beginning of Winter, and therfore is called of the Latines dies brumalis, on which day Christ our Saviour was borne, so as from the time of his birth unto this present yere, there are runne almost thirteene dayes, wherefore, unlesse the Kalenders be reformed as well here in England as elsewhere (for the Roman reformation is not so exactly true as it might be) we shall have in processe of time, the Spring in Winter, and the Winter in Autumne.

How shall I know this present yeere, or any yeere to come hereafter, at what day and houre the Sunne entereth into any of the twelve Signes.

First, you must learne by some good Ephemerides, or other Table, the true entrance of the Sunne into every Signe in

any yéare passed before, then from the time of the entrance of the Sunne into the Signe which you desire to know, consider how many yéares are betwixt, and how many leape yéares are in the same contayned, and subtract for so many times as there be leape yéares, 44′ of an houre, and adde to the houres remayning so many times five houres, and 49′, as there be yéares remayning over and besides the leape yéares, and that summe shall shew you the day, houre, and minutes, of the true entrance of the Sunne into that Signe in the same yéare that you desire to know.

Cahp. XVII.

Of the Horizon both right and oblique, making thereby three kinds of Spheares, that is, the right, the parallel, and the oblique Spheare.

WHat is the Horizon?

It is a great immovable Circle which divideth the upper Hemispheare, which is as much to say, as the upper halfe of the world which we sée, from the nether Hemispheare which we sée not: for standing in a plaine field, or rather upon some high mountayne voyd of bushes and trées, and looking round about, you shall sée your selfe environed, as is were, with a Circle, and to be in the very middest or Center thereof, beneath or beyond which Circle, your sight cannot passe, and therefore this Circle in Greéke is called Horizon, and in Latine Finitor, that is to say, that which determineth, limiteth, or boundeth the sight; the Poles of which Circle are imagined to be two points in the firmament, whereof the one standeth right over your head, called in Arabick Zenith: and the other directly under your foot, called in the same tongue Nadir, that is to say, the point opposite, and from point to point you must imagine that there goeth a right line passing thorow the

the Center of the world, and also thorow your body both head and feet, which is called the Arletræ of the Horizon, and you have to understand, that of Horizons there be two kinds, that is, right and oblique, making three kinds of Spheares, that is to say, the right Spheare, the parallel Spheare, and the oblique Spheare.

When is the Horizon said to be right, and thereby to make a right Spheare?

It may be said to be right two manner of wayes. First, when the Horizon passeth thorow both the Poles of the world, cutting the Equinoctiall with right angles, in which Spheare they that dwell have their Zenith in the Equinoctiall, which passeth right over their heads, to whom the dayes and nights are alwayes equall. Secondly, they are said to have a right Horizon, and to dwell in a right Spheare, to whom one of the Poles of the world is their Zenith, and their Horizon is all one with the Equinoctiall, cutting the Arletræ of the world in the very middest with right angles; and because the Horizon and the Equinoctiall are Parallels, this kind of Spheare is called a parallel Spheare, in which Spheare they that dwell have six months days, and six months nights, as you may easily perceive by placing the Spheare, so as one of the Poles may stand right up in the middest of the Horizon, by meanes whereof you shall see six Signes of the Zodiaque to be alwayes above the Horizon, and six Signes to be alwayes under the Horizon: Againe, by placing the Spheare so as both the Poles may lie upon the Horizon, you shall see the shape of the first right Spheare, wherein the Horizon passeth thorow both the Poles of the world, and the Equinoctiall passeth thorow the Poles of the Horizon, which are the two points called before the Zenith and Nadir.

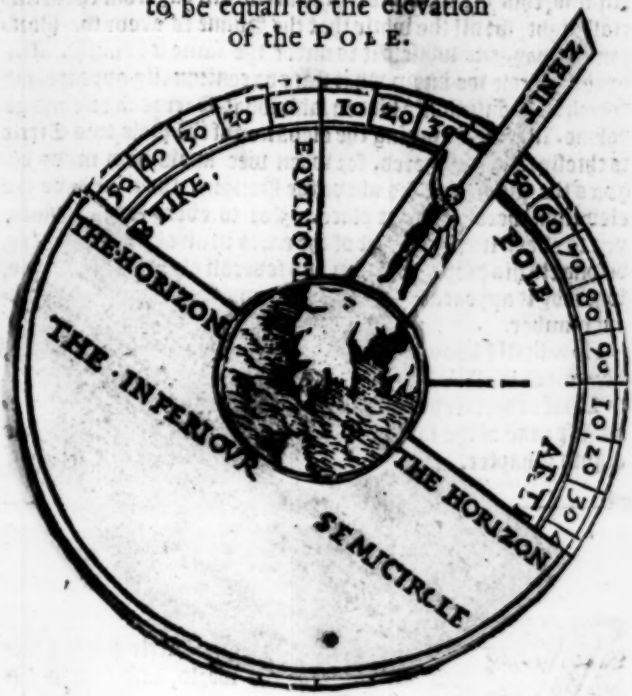
When is it said to be an oblique Horizon, and therby to make an oblique Spheare?

When the Pole of the world is elevated above the Horizon, be it never so little, so as the Horizon do cut the Equinoctiall with oblique angles, and looke how much the Pole of the world is elevated above your Horizon, so much is your

Zenith

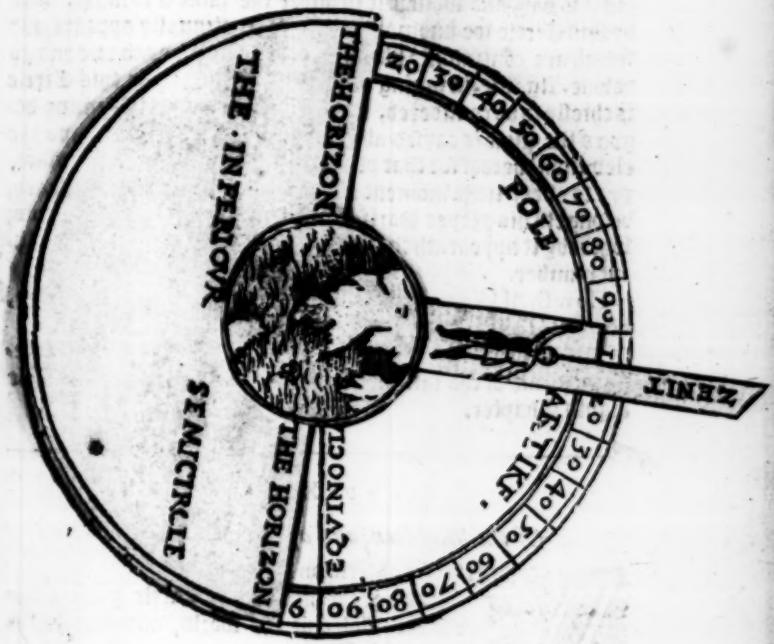
Zenith distant from the Equinoctiall, and the nigher that your Horizon approacheth to the Pole, the nigher your Zenith approacheth to the Equinoctiall. Againe, loke how much the Equinoctiall is elebated above your Horizon, so much is your Zenith distant from the Pole, all which things this figure here following doth plainly shew, whereby you may easily perceive that the latitude, which is the distance of your Zenith from the Equinoctiall, is alwayes equall to the altitude of the Pole, which is the distance betwixt your Horizon and the Pole, as for example; knowing the latitude of Norwich to be two and fifty degrees, lay the Zenith of this figure upon the two and fiftieth degree, reckoning from the Equinoctiall towards the Pole Artique on your left hand, and loke what distance is betwixt the said Zenith and the Equinoctiall, the selfe-same distance you shall finde to be betwixt the Horizon and the fore-said Pole on your right hand: and you may do the like upon the Spheare it selfe, by rayling the movable Meridian above the Horizon at that altitude, so as the two and fiftieth degree may be even with the Horizon.

A Figure shewing the latitude of any place to be equall to the elevation of the POLE.



What

A Figure shewing the latitude of any place to be equall to the elevation of the POLE.



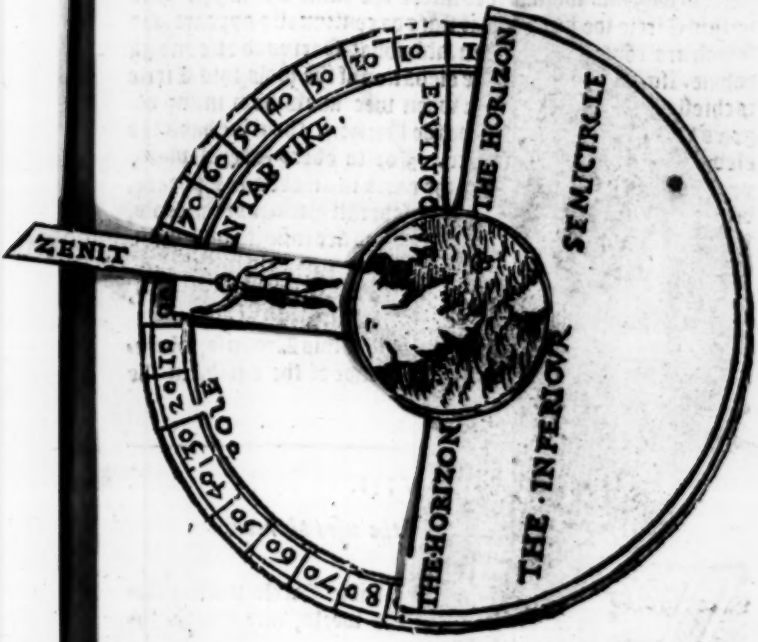
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A Figure shewing the latitude of any place to be equall to the elevation of the POLE.



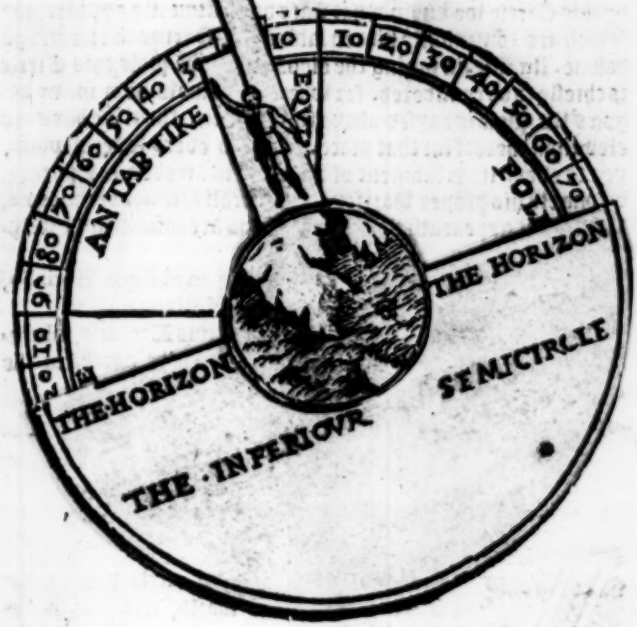
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A Figure ſhewing the latitude of any place to be equall to the elevation of the POLE.



What

A Figure shewing the latitude of any place to be equall to the elevation of the POLE.



What

What other uſes hath this Circle?

In this Circle are ſet down the foure quarters of the world, as Eaſt, Weſt, North, and South, and the reſt of the winds: Againe, this Circle diuideth the artificiall day from the artificiall night, for all the while that the Sunne is aboue the Horizon it is day, and whileſt it is vnder the ſame it is night. And by this Circle we know what ſtars do continually appeare, and which are continually hidden, alſo what ſtarres do riſe and go downe. Againe, in taking the elevation of the Pole, this Circle is chiefly to be conſidered, for when wee know how many degrees the Pole is rayſed aboue the Horizon, then we haue the elevation thereof for that place. For to every ſeverall place, yea to every little moment of the earth in an oblique Spheare, belongeth his proper Horizon and ſeverall altitude of the Pole, whereby it appeareth that the Horizons are infinite and without number.

How ſhall I know in any place, having an oblique Horizon, how much the Pole is elevated aboue the Horizon?

That is declared in the ſecond Booke of this Treatiſe, where as I ſpeake of the latitude and longitude of the earth, in the eighth Chapter.

CHAP. XVIII.

Of the Meridian, and of the uſes thereof.

WHat is the Meridian?

It is a great immouable Circle paſſing thorow the Poles of the world, and thorow the Poles of the Horizon.

Why is it called the Meridian?

Becauſe that when the Sun riſing aboue the Horizon in the Eaſt, commeth to touch this line with the Center of his body, then it is mid-day or noon-tide to thoſe, thorow whoſe Zenith that Circle paſſeth. And when the Sun after his going downe in the Weſt commeth to touch the ſelf-line againe in the point oppoſite, it is to them mid-night. And note, that diuers Cities, having

hauing diuers latitudes, that is to say, being distant one from another North and South, be it neuer so far, may haue one selfe Meridian: but if they be distant one from another East and West, be it neuer so little, then they must néeds haue diuers Meridians, and such distance betwixt the two seuerall Meridians, is called the difference of longitude, whereof we shall speak heereafter more at large, when we come to treat of the longitude and Latitude of the Earth, which something differeth from the longitude and latitude of the starres or Planets, whereof we haue already spoken in the eleuenth Chapter.

How many Meridians be there?

The Astronomers do appoint for euery two degrées of the Equinoctiall a Meridian, so as they make in all 180. Albeit most commonly in the Spheare they set downe but one, which serueth for all by turning the body of the Spheare to it, which for that cause is called the mouable Meridian. And in such Spheares as haue not a foot and a standing Horizon, there is no Meridian at all, but the two Colures are faine to supply their want, but all Terrestriall Globes are commonly described with twelue Meridians, cutting the Equinoctiall in 24 points, and dividing the same into 24 spaces, euery space containing fifteene degrées, which is an houre, by meanes whereof wee know how much sooner or later it is noon-tide in any place, for it is noon-tide sooner to those whose Meridian is more Eastward, then to them whose Meridian is more Westward. And contrariwise the Eclipse of the Sun or Moone appeareth sooner to those, whose Meridian is more Westward.

What other uses hath this Circle?

This Circle diuideth the East part of the World from the West, and also it sheweth both the North and South, for by turning your face towards the East, you shall finde the Sun being in that Line at noon-tide to be on your right hand right South, the opposite part of which Circle sheweth on the left hand the North. Also this Circle, by reason that it passeth thorow both the Poles of the World, diuideth both the Equinoctiall and all his Parallels into two equall parts, as well aboue the Horizon, as vnder the Horizon, and by that means it diuideth the artificiall

ficiall day and artificiall night, each of them into two parts, that is to say, into two semidiurnall, and into two seminocturnall parts. For betwixt that part of the Horizon where the Sunne riseth, mounting still untill he come to this Circle, which is at noon-tide, is contayned the first halfe of the day, and the other halfe is from the same Circle to the going downe of the Sunne under the Horizon. And the first part of the night in the space betwixt the Sunnes going downe and his comming againe to the Meridian, which is at mid-night, and from thence to the time of his rising is the other halfe of the night: and also the Astronomers take the beginning of their naturall day from this Circle, counting either from noon-tide to noon-tide, or else from mid-night to mid-night. Againe, this Circle sheweth the right ascentions and declinations of the stars, and the highest altitude, otherwise cãlled the Meridian altitude of the Sunne, or of any starre, or degrée of the Ecliptique, or of any other point in the firmament: all which uses and many others more you shall better understand hereafter, when wée come to shew the uses of the Globe, as well Terrestriall as Celestiall.

Chap. XIX.

Of the verticall Circles, and uses thereof

But here you have to note, that though the most part of Geographers do set downe in their Speares but six great Circles, yet there is another great Circle called the Circle Verticall, which passeth over our heads, thorow our Zenith, whersoever we be upon the Land or Sea, crossing our Horizon in two points opposite, and dividing the same into two equall parts, and such kind of Circles are called in Arabick Azimuths, whereof you may imagine that there be so many as there be Rumbs or winds in the Mariners Compasse, which are in number 32, yea and if you will, you may

may make halfe so many as there bee degrées in the Horizon, which are in number 360, the halfe whereof is 180. If you be right under the Equinoctiall, and do go or saile right East or West, then the Equinoctiall is your verticall Circle, and if you go or saile right North or South, than the Meridian is your verticall Circle, which two Circles notwithstanding do alwayes kepe their names. But in sayling by any other Rumb, that Circle which is imagined to passe from the true East-point right over your head unto the true West-point, or which crosseth your Meridian in the Zenith point with right Sphericall angles, is most properly called the verticall Circle: and the learned Sea-men have great respect to two speciall kinds of verticall Circles, that is, the Magneticall Meridian, and the Azimuth of the Sunne.

What manner of verticall Circles be those, and whereto serve they?

M. Borough in his Discourse of the variation of the Compasse, defineth the Magneticall Meridian to be a great Circle, which passeth thorow the Zenith, and the Pole of the Loadstone called in Latine Magnes, and divideth the Horizon into two equall parts by crossing the same in two points opposite. Againe, the Azimuth of the Sunne is a great Circle, passing thorow the Zenith, and the Center of the Sun in what part of the Heaven soever he be, so as he be above the Horizon, which Circle divideth the Horizon into two equall parts, by crossing the same into two points opposite. And by helpe of these two Circles and a certaine Instrument made of purpose to give a true shaddow, he teacheth to finde out the true Meridian of any place: and also to know how much any Mariners Compasse doth vary from the true North and South, in North-easting or North-westing, whereof I shall speake more at large hereafter in my Treatise of Navigation.

What use is there of the verticall Circles or Azimuths?

The verticall Circle sheweth what time the Sunne or any other Star rising beyond the true East-point, is passed that East point, as also when the Sunne or said Starre commeth to the true East, or any other Rumb. Also in what Coast or part of Hea-

Heauen, the Sunne, Moone, or any other starre is at any time being mounted aboue the Horizon, as whether it be Southeast or Northeast, or in any other Rumb: Also by helpe of the verticall Circle most properly so called, are the twelue Houses of Heauen set, according to Campanus and Gazula. And by helpe of these Circles, you may also know how any place upon the Earth beareth one from another either Eastward or Westward, and so forth, for euery place hath his seuerall Azimuth answerable to the Horizon and Zenith of the said place.

Of certayne Circles called Almicanteraths.

Since I haue spoken here some-what of the verticall Circles called Azimuths, it shall not be amisse, to shew you also that there be other Circles to be considered of in the Spheare, aswel as in the Astralabe, called Almicanterathes, that is to say, Circles of Altitude, which though they be not all great Circles, for euery one is lesser than other, proceeding from the oblique Horizon of any place to the Zenith of the said place, yet the first Almicanterath which is the very oblique Horizon it selfe, is a great Circle dividing the Spheare into two equall parts, and all the rest are lesser and lesser, untill you come to the very Zenith, and are Parallels to the Horizon euen as the Tropiques and the other lesser Circles are Parallels unto the Equinoctiall. And the Zenith, in Sphericall bodyes, is the Center of them all, though it be not so in Astrolabes, for there euery Almicanterath is faine to haue his seuerall Center, of which Circles there be in all ninty, according to the number of ninty degrees, contayned betwixt the oblique Horizon and the Zenith, & these Circles do serue to shew the altitude of the Sunne or Moone, or of any other starre fixed or wandring, being mounted at any time aboue the oblique Horizon, which is easie to be found by any Quadrant, Crosse-staffe, or Astrolabe: but leauing to speake any further of these Circles, because they are not used to be described in Spheares, but only in Astrolabes, I will now treat of the foure lesser Circles, before mentioned, which are commonly set downe in euery Spheare or Globe.

Chap. XX.

Of the foure lesser Circles, that is to say, the Circle Arctique, the Circle Antarctique, the Tropique of Cancer, *and the Tropique of* Capricorn, *and also of the five Zones, that is to say, two cold, two temperate, and one extremly hot.*

Which call you the lesser Circles?

They are those that do not divide the Spheare into two equall parts, as the great Circles do, and of such there be foure, that is, the two Polar Circles, and the two Tropiques, that is to say, the Tropique of Cancer, and the Tropique of Capricorne; of which Polar Circles the one is called Arctique, and the other Antarctique, and are made by the turning about of the two Poles of the Zodiaque, which Poles being situated in the Colure of the Solstices are so farre distant from the Poles of the World, as is the greatest declination of the Sunne from the Equinoctiall, which is 23 degrées, 30', as hath béene sáid before.

Which is the Arctique Circle? and why is it so called?

The Arctique Circle is that which is next to the North-Pole, and hath his name of this word Arctos, which is the great Beare or Charles-wayne, which are seven starres placed next to this Circle on the out-side thereof, and it is otherwise called the Septentrionall Circle, of this word Septentrio, which is as much to say, as seven Oxen, signified by the seven starres of the little Beare, which do move slowly like Oxen, and are placed all within the said Circle, and the bright starre that is in the tippe of the tayle of the said little Beare, is called of the Mariners the Load starre, or North starre, whereby they sayle on the Sea, and the Center of the Circle is the North Pole of the World, which is not to be séene with mans eye.

What is the Antarctique Circle?

It is that which is next unto the South Pole, and is so called, because it is opposite or contrary to the Circle Arctique.

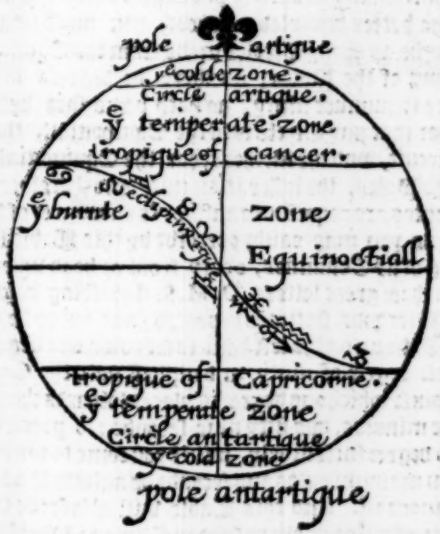
Now describe the two Tropiques?

The Tropique of Cancer is a Circle imagined to be betwixt the Equinoctiall and the Circle Arctique, which Circle the Sunne maketh when he entreth into the first degree of Cancer, which is about the twelfth or thirteenth day of Iune, being then in his greatest declination from the Equinoctiall Northward, and nighest to our Zenith, being ascended to the highest point that he can go, at which time the dayes with us bee at the longest, and the nights at the shortest. And so from thence he declineth to the other Tropique called the Tropique of Capricorne, which is a Circle imagined to be betwixt the Equinoctiall and the Circle Antarctique, which the Sunne maketh when he entreth into the first degree of Capricorne, wich is about the twelfth or thirteenth day of December, at which time he is againe in his greatest declination from the Equinoctiall Southward, and furthest from our Zenith: whereby the dayes with us be then at the shortest, and the nights at the longest: And note, that these two Circles are called Tropiques, of this Greeke word Tropos, which is as much to say, as a conversion or turning, for when the Sunne arriveth at any of these two Circles, he turneth backe againe either ascending or descending, by reason of which foure Circles as well the firmament as the earth is divided into five Zones, that is to say, two cold, two temperate, and one extremly hot, otherwise called the burnt Zone, of which five Zones, the foresaid foure Circles are the true bounds. For of the two cold Zones, the one lyeth betwixt the North Pole and the Circle Arctique, and the other lyeth betwixt the South Pole and the Circle Antarctique; and of the two temperate Zones, the one lyeth betwixt the Circle Arctique and the Tropique of Cancer, and the other lyeth betwixt the Circle Antarctique and the Tropique of Capricorne; and the extreme hot Zone lyeth betwixt the two Tropiques, in the middest of which two Tro-

piques

piques is the Equinoctiall line, as you may see in this figure, and also in the Spheare or Globe it selfe.

A figure shewing the five foresaid Zones.



Of which Zones, the ancient men were wont to say, that three were unhabitable, that is, the two cold, and the extreme hot, which experience sheweth in these later dayes, to be untrue, as we shall declare more at large when we come to treat of the division of the Earth: Againe, you have to understand, that every one of these lesser Circles doth containe in length 360 degrees, as well as every one of the greater Circles, but the degrees are not of like bignesse, no more than the Circles themselves are like in compasse or circuit, for the lesser the Circles are in circuit, the lesser their degrees must needs be.

Sith every of the lesser Circles differ one from another in circuit, and thereby the degrees of every Circle be lesse than other, how shall I know the true quantity of every degree in each Circle, and how many minutes are required in every lesser degree proportionally to answer one degree of the Equinoctiall?

For the better knowledge hereof, you must imagine that there may be as many Circles made from the Equinoctiall towards any of the Poles, as there be degrées of latitude, which are in number ninty, as hath beene said before: And the nigher that any Circle is to the Equinoctiall, the greater it is in circuit, and the further from the Equinoctiall towards any of the Poles, the lesser in circuit; and therefore more or lesse minutes are requisite to answer to one degrée of the Equinoctiall, as you may easily perceive by this Table following, consisting of six Columnes, every front or head whereof is noted with three great letters, D. M. S. signifying degrées, minutes, and seconds, sixtimes repeated; and in the beginning of the first Column on the left hand is set down one degrée, which is the first degrée of ninty, and nigheſt unto the Equinoctiall, right against which one degrée is placed towards the right hand fifty nine minutes, and fifty nine seconds: so proceeding from degrée to degrée successively, untill you come to ninty, you shal finde how many minutes and seconds do answer to one degrée of the Equinoctiall. And this Table will also serve to shew the difference of miles in every sundry Clime or Parallel, whereof we shall speake hereafter when we come to treat of the Earth.

A Table shewing how many minutes are requisite to make one degree in every lesser Circle, answerable to one degree of the Equinoctiall.

D.	M.	S.	D.	M.	S.	D.	M.	S.	D.	M.	S.	D.	M.	S.	D.	M.	S.
1	59	59	16	57	41	31	51	20	46	41	41	61	29	5	76	14	31
2	59	57	17	57	23	32	50	53	47	41	52	62	28	10	77	13	30
3	59	53	18	57	45	33	50	29	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	45	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	11	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

Chap. XXI.

Of the starres and Celestiall bodies contayned in the Firmament, and first of their substance.

Having briefly described all the Circles as well greater as lesser that are imagined to be in the eighth Heaven: I think it good now to speak somwhat of the stars and celestial bodies, placed in the said Heaven. And first of their substance, and then of their moving, figure, shape, number, magnitude or greatnesse, alse of their longitude, latitude, declination, ascention, descention, both right, and oblique,

and of the ascentionall difference, and finally of the threefold Poeticall rising and going downe of the starres, but first of their substance.

Of what substance are the starres?

The starres bee of the same substance that the Heavens are wherein they are placed, differing only from the same in thicknesse, and therefore some defining a starre do say, that it is a bright and shining body, and the thickest part of his Heaven, apt both to receive and to retayne the light of the Sunne, and thereby is visible and object to the sight: for the Heaven it selfe being most pure, thinne, transparant, and without colour, is not visible, and for this cause the milke-white impression in Heaven, like unto a white way, called of the Astronomers Galaxia, and of the common people, our Ladyes way, is visible to the eye, by reason that it is thicker than any other part of the Heaven.

Why are not the starres seene as well in the day, as in the night?

Because they are darkned by the excellent brightnesse of the Sunne, from whom they borrow their chiefest light.

Chap. XXII.

Of the moving and shape of the starres.

What moving have the starres?

The selfe-same moving that the Heaven hath wherein they are placed.

Whereby are the Heavens moved?

Some say, that the first movable is turned by God himselfe, and all the rest of the Heavens every one by his proper intelligence, which though it turneth his Heaven about, yet it giveth neither life, sense, nor understanding thereunto, as some have untruly holden, affirming the Heavens to bee living and intelligible bodies.

If the starres have no moving of themselves, whereof commeth it then, that some seeme to our sight sometime nigher, and sometime further off?

All

All the fixed starrs of the firmament are alwayes of like distance, notwithstanding by reason of the manifold moving of the firmament wherin they are placed, they seeme to change their places, and sometimes to be more towards the East or West, North or South. And whereas the seven Planets, called the wandring starres, do change their places now here, now there, that chanceth not by their owne moving, but by the moving of the Heavens wherein they are placed: for a starre being round of shape hath no members meet to walke from one place to another, but only changeth his place through the motion of his Spheare or Heaven wherein such a Planet is fixed.

Chap. XXIII.

Of the number of the starrs, and of their magnitude or greatnesse, and into how many Images they are divided, and how many starres every Image containeth.

May the starres be numbred by man?

No; for as David saith, that belongeth only to God, who as hee created them, so hee can number them, and call them all by their names, notwithstanding the Astronomers by their industry and diligent observation have attayned to the knowledge of many: as first they know the seven Planets, otherwise called the wandring starres, and have made manifest demonstrations of their motions, and by continuall observation have found out the manifold vertues, powers, and influences of the same, but of the fixed starres they could never finde more than 1022. And because the starrs are not equall in greatnesse or bignesse, they make six differences of greatnesse, appointing to the first difference fixtene starres, which are bigger than all the rest, whereof every one containeth the Earth 207 times, to the second difference, five and forty starres, whereof every one containeth the

Earth ninty times. To the third they appoint 208 ſtarres whereof every one contayneth the Earth 72 times. To the fourth difference they appoint 474 ſtars, whereof every one contayneth the Earth 54 times. To the fift they aſſigne 217 ſtarres, whereof every one contayneth the Earth 57 times. To the firſt or laſt greatneſſe they appoint 49 ſmal ſtars, wherof every one contayneth the Earth eighténe times, and ſome ſay twenty times. Beſides theſe, there be fourténe others, whereof five be called cloudy, and the other darke, becauſe they are not to be ſéene but of a very quick and ſharpe ſight. And you have to note, that the ancient Aſtronomers do divide all the fixed ſtars to them knowen into 48 Images, whereof they liken ſome to living things, as to men, women, beaſts, monſters, fowles, fiſhes and créeping wormes, and to ſome things without life, having ſome artificiall ſhape, of which 48 Images, they appoint 12 to the Zodiaque, commonly called the twelve Signes, as Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, and Piſces. Againe, they place in the Northy part of the firmament 21 Images, and in the South part thereof fifténe Images, which make in all 48. The deſcription of all which Images, together with their names hereafter followeth: and firſt I will deſcribe unto you the twelve Images contayned in the Zodiaque.

Cahp. XXIIII.

Of the twelve Images or Signes of the Zodiaque.

THe twelve Signes (as ſome affirme) do contain of the foreſaid number of fixed ſtarres 273, for the firſt Signe called Aries, that is to ſay, the Ramme, contayneth 13 ſtars, which Image or Signe being placed in the conjunction of the Zodiaque with the Equinoctiall, hath his backe turned towards the North, and his head towards the Eaſt, and riſeth with his head, and goeth downe with his feet.

The

The second Signe called Taurus, that is to say, the Bul, containing 33 ſtars, whereof there is one bright ſtar of the firſt bigneſſe called Occulus Tauri, that is to ſay, the Buls eye, who hath his head enclined towards the Weſt, as though he loked towards the Earth, and riſeth and goeth downe with his heeles upward. The third Signe called Gemini, that is to ſay, the Twins do contayn eightene ſtars, their heads loking towards the North, and their backs being joyned together do imbrace one another, do riſe lying, and do go downe with their feet. The fourth Signe called Cancer, that is to ſay, the Crab, contayneth nine ſtarres, extending his feet towards both the Poles, and loking towards Leo, hath his belly turned towards the earth, and he riſeth and falleth with his hinder part or back-part of his body. The fifth Signe called Leo, that is to ſay, the Lyon contayneth ten ſtars, whereof there be two bright ſtarres of the firſt bigneſſe, the one in his breſt called Cor Leonis, and Regulus, that is to ſay, the Lyons heart, and the other in his tayle called Cauda Leonis, that is to ſay, the Lyons tayle, who loketh towards Cancer, and having his back turned towards the North, he riſeth and goeth downe with his head. The ſirth Signe called Virgo, that is to ſay, the Virgin, whoſe head is behind the Lyon, and toucheth the Equinoctiall line with her left hand, holding in the ſame hand an eare of Corn, ſhe both riſeth and goeth down with her head: this Image contayneth fyve and twenty ſtars, whereof there is one bright ſtarre of the firſt bigneſſe, called Spica Virginis, that is to ſay, an eare of Corne. The ſeventh Signe called Libra, that is to ſay, the Ballance, contayning eight ſtars, hath two ſcales, whereof the one hangeth towards the North, and the other towards the South. The eighth Signe called Scorpio, that is to ſay, the Scorpion, contayneth one and twenty ſtars, who loketh towards Virgo, and extendeth his feet towards both the Poles, he boweth his tayle towards the North, having his belly turned toward the Earth, and he riſeth and goeth downe bowing: The ninth Signe called Sagittarius, that is to ſay, the Archer, contayning one and thirty ſtarres, hath his head towards the North, and loketh towards the Scorpion, having a bow and a ſhaft, whereof

the

the bow toucheth his left hand, and his left foot, he riseth right up and goeth downe headlong. The tenth Signe called Capricornus, that is to say, the Goat, containing eight and twenty starres, hath his backe turned towards the North, and his head towards the Archer, and turning himselfe towards Aquarius, he riseth right up, and goeth downe headlong. The eleventh Signe called Aquarius, that is to say, the Water-bearer, containing two and forty starres, hath his head towards the North, extending his left hand upon the backe of Capricorne, and with his right hand poureth water out of his pot, which bendeth towards the East, runneth even to Pisces, he riseth and goeth downe with his head before any other of his members. The twelfth Signe called Pisces, that is to say, two Fishes, do containe foure and thirty starres, whereof the backe of the first is towards the North, and the backe of the second towards the West arme of Andromeda, and one of the Fishes looketh towards Aquarius, and the other towards the North, and betwixt these two Fishes is a certayne little Line, wherewith their tayles are bound together, as it were with a band, the lower part of which Fishes doth alwayes both rise and go downe, and not the upper part. And though the twelve Signes of the Zodiaque are said to bee equall both in length and breath, that is to say, having thirty degrees in length, and twelve degrees in breath, as hath beene said before, yet these Images are not equall, for some do extend further than the Zodiaque in breath, and some are more than thirty degrees in length. As the Tables of Alphonsus do manifestly shew, who saith there, that the twelve Signes do containe three hundred and fifty starres, for he appointeth to Aries eightene, to Taurus forty foure, to Gemini twenty five, to Cancer thirteene, to Leo thirty five, to Virgo thirty two, to Libra seventeene, to Scorpio twenty foure, to Sagittarius thirty and one, to Capricornus twenty eight, to Aquarius forty five, to Pisces thirty eight, which make in all three hundred and fifty: in which Tables are also set downe the longitude, latitude, and magnitude of the said starres, but the longitude of the said starres is farre altered from that longitude

which

which they had in his time, whereof we shall speake hereafter more at large.

Chap. XXV.

Of the one and twenty Northerne Images.

WHich be they?

These here following; first, Vrsa minor, that is to say, the lesser Beare, containing seven starrs, the tayle-starre whereof being a bright star of the third bignesse, is called the loade-star: The second is called Vrsa major, that is to say, the great Beare, containing seven and twenty starres, whereof there be seven principall, making a shape like unto a Cart with foure wheeles, and therefore it is commonly called Charles Wayne. The third is called Draco, that is to say, the Dragon that kept Iuno's Orchard from robbing, containing one and thirty starrs. The fourth is called Cepheus, the proper name of a King of Ethiope, containing eleven starrs. The fift is called Bootes, that is to say, the rowing keeper of the Beare, containing 22 starrs, whereof there is one bright star betwixt his legs, of the first bignesse, called Arcturus. The sixt is called Corona Ariadnæ, that is to say, the Crowne of Ariadna the daughter of King Minos, containing eight starrs. The seventh is Hercules, who lyeth grovelling with his heeles towards the North Pole, holding a Club in his right hand, and a Lyons skin hanging on his left arme, containing 28 starrs. The eighth is called Lyra, that is to say, an instrument of Musick like a Harp, placed in Heaven in the memory of Orpheus, containing ten starres. The ninth is called Cignus, that is to say, the Swanne, into which Iupiter transformed himselfe to deceive the Nimph Læda, containing seventéene starrs. The tenth is called Cassiopeia sitting in her chayre, Wife to Cepheus, and Mother to Andromeda, containing thirtéene starrs. The eleventh is called Perseus, holding his sword in the one hand, and the head of Gorgon or Medusa in the other hand, whose haires were all Serpents, containing twenty six starres.

starrs. The twelfth is Auriga and Erictonius, who was the inventer of the first Chariot that ever was made, containing thirtéen starres. The thirtéenth is called Serpentarius and Anguitenens, that is to say, he that holdeth the Serpent, who (as some thinke) was Æsculapius the famous Phylitian, containing foure and twenty starres. The fourtéenth is called Serpens, or Anguis, that is to say, the Serpent of Æsculapius containing eightéene starres. The fiftéenth is called Sagitta or Telum, that is to say, the shaft or dart wherewith Hercules slew the Eagle tormenting Prometheus in the mount Caucasus, containing five starres. The sixtéenth is called Aquila, that is to say, the Eagle which carryed Ganimedes into Heaven, containing nine starres. The seventéenth is called Delphinus, that is to say, the Dolphin, which saved Arion that excellent Phylitian being cast by Pirats into the Sea, containing ten starrs. The eightéenth is called Minor Equus, that is to say, the lesser Horse, containing only foure little dark starrs in his head. The nintéenth is the great Horse called Pægasus, that is to say, the winged Horse, wherewith Bellerophon conquered the monstrous beast called Chimera, which was halfe a Lyon and halfe a Dragon, and is adorned with twenty starrs. The twentieth is called Andromeda, the Daughter of Cepheus, by Cassiopeia, and Wife to Perseus, who for her constant love towards her Husband, was placed in Heaven nigh unto him, and was adorned with three and twenty starrs. The one and twentieth is called Triangulum, that is to say, a Triangle or three cornered figure, which being like in shape to the Ile Sicilia, the Goddesse Ceres obtayned to be placed in Heaven, and was adorned with foure starres, that is to say, every corner one, and the fourth in the middest of the shortest side: To these (in mine opinion) ought to be added Bernices haire, called crinis Bernices, which in all Celestiall Globes is placed not farre from the right hinder foot of the great Beare, and this Image containeth foure little starres.

CHAP.

Chap. XXVI.

Of the fifteene Southerne Images.

WHich be they?

These hereafter following, whereof the first is called Cætus, that is to say, the Whale, that monstrous fish, which by the appointment of Neptune would have destroyed Andromeda, whom Perseus delivered by killing the fish, and afterwards took Andromeda to wife, which fish Neptune placed in Heauen, adorning the same with two and twenty starres. The Second is called Orion, with his sword by his side, who afterward was slaine by Diana, by mishap against her will, for the which she placed him in Heaven, adorning him with eight and thirty starres, whereof there bee two bright starres of the first bignesse, the one in his right shoulder, called Bed Alguze, and the other in his left foot called Rigell Alguze. The third, is the floud called Eridanus, into the which Phaeton the son of Apollo was stricken with a thunder bolt by Iupiter for burning the earth, by rashly driving his Fathers Chariot, which hee was not able to guide, in memory whereof the floud was placed in Heaven, and adorned with 34 starres, whereof one is a bright starre of the first bignesse called Acarnar. The fourth is called Lepus, that is to say, the Hare, placed nigh unto Orion, because he was a Hunter, adorned with twelve stars. The fift is called Canis major, that is to say, the great Dog, passing all other in swiftnesse, which was given by Aurora to Cepheus the Son of Æolus, and is placed next to the Hare, being adorned with eightene starres, whereof there is in his mouth a very faire starre of the first bignesse called Syrius. The sixth is called Canis minor, that is to say, the lesser Dogge, without the which Orion his Master would not be placed in Heaven, which hath but two starres, whereof the one is in his flancke, and is a bright starre of the first bignesse called Canicula and Porcion. The seventh is the ship called Argos, in the which Iason and his companions

sailed

sailed to Colcos, to winne the golden Fleece, which is adorned with 45 starres, whereof there is one bright star of the first bignesse in the left Dare called Canopus. The eighth is called Hydra, that is to say, the Water serpent which Hercules slew, or as some say, which kept the Water-bowle, and would not suffer the thirsty Crow to drinke, which Crow Apollo sent for Water to do sacrifice, and is adorned with 25 starrs. The ninth is called Crater, that is to say, the Cup or Bowle which the Crow brought too late unto Apollo, and therefore his feathers were made all blacke, where as before they were white, containing seven starrs. The tenth is called Corvus, that is to say, the Crow before mentioned, adorned with seven starrs. The eleventh is called Chiron five Centaurus, the Sonne of Saturne, passing all others in justice and religion, and therefore is figured in heaven as though he were offering sacrifice upon an Altar, adorned with 37 starrs, whereof there is one bright starre of the first bignesse in his right foot, called Chiron and Centaurus. The twelfth is called Lupus, that is to say, the Wolfe, into which Licaon the cruell Tyrant was turned by Iupiter, or as some say, that Wolfe which Centaurus killed to do sacrifice upon the Altar, containing nineteene starrs. The thirteenth is called Ara, that is to say, the Altar made by the Smiths of Vulcan, whereupon all the gods sware to revenge the insolency and pride of the Giants, which Altar is placed next to Centaurus, being adorned with seven starrs. The fourteenth is called Corona Australis, that is to say, the Southerne Crowne which Bacchus did weare when he fetched his Mother Semele from Hell, which is placed in heaven, and is adorned with thirteene starrs. The fifteenth and last of the Southerne Signes is called Pisces Australis, that is to say, the Southerne Fish which was placed in heaven, in the memorial of the fishes which the people of Syria did worship as their gods, and is adorned with twelve starrs, whereof there is one bright star of the first bignesse in his mouth called Fomahant. All which Images and Signes before mentioned, as well Northerne as Southerne, you may see plainly described in every celestiall Globe, and also set forth in Plano in the nether end of Vopellius his tenth generall Map, that is

to

to ſay, the Northerne Signes on the left ſide, and the Southern Signes on the right ſide of the Map or in the Front of Planctius his great univerſall Map, who in the Rondle repreſenting the Southerne halfe of the celeſtiall Globe, ſetteth downe alſo certaine Southerne ſtarres lately found out by the travellers into the Indies, as the Croſſe, the Southerne Triangle, Noah his Dove or Pigeon, and another in ſhape of a Man called Polophilax, ſo as there be now in all 19 Southerne Images.

CHAP. XXVII.

Of the longitude of the fixed ſtarres, and of the preceſſion of the vernall Equinoctiall point, and what it is.

WHat is the longitude of a ſtarre?

The longitude of any ſtarre, is that Arke or portion of the Ecliptique line, which is contayned betwixt the firſt point of Aries, and the Circle which paſſeth through the Poles of the Zodiaque, and alſo through the body of the ſtarre, as for example, the ſtarre called Cor Leonis, is diſtant in theſe dayes from the vernall Equinoctiall point of the Ecliptique line 143 degrées, and 32', and thereby is found to be in 23 degrées, and 32' of Leo: againe, the ſtar called Spica Virginis, in theſe dayes is diſtant from the firſt point of Aries, 198 degrées, and ſo is found to be in the eightenth of Libra,

Why do you ſay in theſe dayes?

Becauſe the fixed ſtarres in proceſſe of time, do change their longitude by reaſon of their proper moving upon the Poles of the Zodiaque, which is from Weſt to Eaſt, for whereas Spica Virginis in Ptolomies time was in the 26 degrée of Virgo, it is found now to be in the eightenth of Libra, the cauſe whereof is the preceſſion of the Equinoctiall point or ſection.

Define what that Preceſſion is.

It is an Arke or portion of the Ecliptique line, contayned betwixt

twixt two great Circles, both paſſing thorow the Poles of the Zodiaque, in ſuch ſort as the one paſſeth thorow the firſt minute of the vernall Equinoctiall point of the ſaid Ecliptique, and the other Circle paſſeth thorow the firſt or former ſtarre of the Rams horne, from which ſtarre the Aſtronomers do make all the celeſtiall motions and revolutions to take their firſt beginning, and this ſtarre in old times paſt was known to be before the vernall Equinoctiall point, which is the firſt mouent of Aries, but now it is found to haue paſſed that point ſo farre towards the Solſticiall point, as in theſe dayes it is knowne to be in the 27 degrés, and 42′ of Aries, and in proceſſe of time it will be cleane out of Aries, and enter into Taurus.

Cahp. XXVIII.

Of the latitude of the fixed ſtarres.

WHat is the latitude of a ſtarre?

The latitude is none other thing, but the diſtance of any ſtar from the Ecliptique line, either towards the North or South Pole of the Zodiaque, and ſuch latitude neuer changeth or altereth, for as the ſtarre Spica Virginis, is at this preſent two degrés diſtant from the Ecliptique line towards the South, ſo it euer hath bẽn, and euer ſhall be, and the like is to be ſaid of all thereſt of the fixed ſtarres, which do alwayes kéepe their latitude, be it Northward or Southward, néere to the Ecliptique, or farre from the ſame.

Chap. XXIX.

Of the declination of the fixed ſtarres.

WHat is the declination of a Starre?

The declination is none other thing, but the diſtance of any fixed ſtarre from the Equinoctiall, either Northward or Southward, which is mutable as well as the longitude: for as the fixed ſtars do change their longitude, ſo alſo by little and little they decline either more or leſſe from the Equinoctiall: As for example, the declination of the ſtar called Canicula, that is to ſay, the leſſer Dogge, in the yeare of our Lord 138, when Ptolomy lived, was fiftene degrées, 44′, and 38″, towards the South. But in theſe dayes the declination of the ſaid ſtarre is but ſix degrées, and 7′ towards the South, and by reaſon that the fixed ſtars in proceſſe of time do change their longitude and declination, they are not alwayes under one ſelfe Signe, but do ſtir out of one Signe into another.

How is the longitude, latitude, and declination of any ſtarre to be knowne? and how are the ſtars themſelves to be knowne in the firmament?

The longitude, latitude, and declination of any ſtar, is to be knowne moſt truly by the Aſtronomicall Tables calculated of purpoſe, and you may know the ſame alſo without having regard to every ſmall minute, by helpe of the Celeſtiall Globe, all the neceſſary uſes whereof, I have ſet downe in my Treatiſe thereof, and there I alſo ſhew you how to find out any ſtar in the firmament that is deſcribed in the Globe, in which Globe are ſet downe as many ſtars as ever were knowne, a few excepted towards the South Pole, which were found out but of late dayes, of which ſtarres I ſhall have occaſion to ſpeak hereafter in my Treatiſe of Navigation. In the meane time, I will proceed to the aſcention and deſcention of the ſtarres, both right, meane, and oblique.

Chap. XXX.

Of the aſcention and deſcention, that is, the riſing and ſetting of the ſtarres, as well according to the Aſtronomers, as according to the Poets.

DO the Aſtronomers and Poets differ touching this matter?

Yea, they differ greatly, as well in name as in matter: for whereas of the Poets it is called ortus & occaſus Signorum, that is to ſay, the riſing and falling of the Signes, ſo of the Aſtronomers it is called aſcentio & deſcentio Signorum, that is to ſay, the aſcention and deſcention of the Signes: Againe, they differ in matter, or rather in manner, for that the Aſtronomers do conſider the riſing and falling of the ſtarres more exactly than the Poets: for the Aſtronomers do conſider the degrées and minutes of the ſame, and alſo do ground their aſcention and deſcention upon more certayne demonſtrations than the Poets. Moreover, whereas the Poets by their manner of riſing and falling, do ſimply ſet downe the time of things done, or to be done, the Aſtronomers do the ſame a great deale more exactly, and by their manner of aſcention and deſcention do conſider the encreaſe and decreaſe of the dayes: of the which Aſtronomicall aſcention and deſcention, I mind here to treat, firſt in generall, and then in particular.

Chap.

Chap. XXXI.

Of the Astronomicall ascention and descention in generall, both right, meane, and oblique, and what a given Arke is.



Define what the Astronomicall ascention and descention is?

Astronomicall ascention is that portion or Arke of the Equinoctiall Line, which riseth together with some given Arke of the Ecliptique Line above the Horizon, and the descention, is that portion or Arke of the Equinoctiall, that goeth downe or setteth together with some given Arke of the Ecliptique Line under the Horizon, according to the moving of the World, which is from East to West.

What mean you by given Arke?

A given Arke is as much to say, as some supposed portion of the Ecliptique or of any other Circle, as if you would know the ascention of some supposed portion of the Ecliptique, containing for example 25, or 30 degrees, here this portion of the Ecliptique containing that number of degrees, is called the given Arke, of which Arkes some are called continuall, and some discrete or divided, which I mind to english here, whole and broken, for so I do english quantitas continua, & discreta, in my Logick. That Arke is said to be continuall or whole which taketh his beginning from the first point of Aries, and so proceeding orderly, endeth at some other degree of the said Ecliptique. And that Arke is called discrete or broken, which doth not take his beginning from the first point of Aries, but beginneth at some other degree of the Ecliptique, as for example; suppose that it beginneth at the fourteenth of Taurus, and endeth at the fifteenth of Gemini, this Arke is called a divided or broken Arke, because it doth not begin at the first point of Aries, and so proceed successively. Moreover you have to understand, that the ancient Astronomers do commonly make but two kindes of ascention and descention, that is, right and oblique, but there be in-

ded three kinds of ascention, that is to say, right, oblique, and meane ascention.

When is any ascention said to be right, oblique, or meane?

It is said to bee right, when the portion of the Equinoctiall which riseth or goeth downe together with the Ecliptique, is greater or more in circuit than that of the Ecliptique. And it is said to bee oblique, when that portion of the Equinoctiall which riseth or falleth together with the Ecliptique, is lesser than that of the Ecliptique: Againe, that is said to be meane ascention, when that portion of the Ecliptique, which ascendeth, is neither greater nor lesser than that of the Equinoctiall: for as in the right Spheare every quarter of the Ecliptique hath a meane ascention, and equall to every quarter of the Equinoctiall, beginning the quarters at any of the foure principall points, so if you take three Signes in any other part of the Zodiaque, their ascentions will not agree with a quarter of the Equinoctiall, sith there is no one Signe that doth equally agree with the like portion of the Equinoctiall: and all this matter dependeth upon the knowledge of the use of certayne Circles before defined.

Which be they?

These three, the Zodiaque, the Equinoctiall, and the Horizon: for first, the Zodiaque doth shew the place of the Sun, that is to say, in what degree it is of any signe, together with the minutes of the same, and turning about every day by the diurnall motion, doth both appeare above the Horizon, and also is hidden under the Horizon. Secondly, the Equinoctiall with his equall rising and going downe, doth measure the time of the Sunne whilest he maketh his abode unequally and diversly above the Horizon. Thirdly, the Horizon divideth the one Hemispheare from the other, on which Horizon, is to be considered what angle any Signe or Star maketh therewith, in his ascention or descention: and according as any portion of the Ecliptique riseth or setteth rightly or obliquely, so in respect of the angle, which it maketh with the Horizon, it is called a right or oblique ascention or descention.

Why should the ascentions and descentions bee measured

rather

rather by the Equinoctiall line than by the Ecliptique, sith the course of the Sunne measureth all times.

The cause thereof is the obliquity of the Zodiaque, having divers and variable situations, whereby the Sunne abideth some times a great while above the Horizon, and some times but a little while, all which inequality is only to be measured by the Equinoctiall, which is alwayes equally moved upon his Poles. Hitherto of the Astronomicall ascention and descention in generall: Now of all three ascentions and descentions in particular.

Chap. XXXII.

Of the right, oblique, and meane ascention in particular, and of the chiefest causes of such diversity of ascention.

And for the better understanding of the Astronomicall ascention and descention, we will make this division: for either it is of some point or starre, or else of some portion of a Circle, chiefly of the Ecliptique line. In the ascention of any point or starre, wee consider two things, first what angle it maketh with the Horizon either right or oblique. Secondly, the time from the rising of the first minute of Aries, which is the first beginning of the longitude of any star or Circle in heaven: and in respect of the Angle every ascention is said to be right in a right Spheare, and oblique in an oblique Spheare. Again, the time of the ascention is to be measured by the degrees of the Equinoctiall from the first minute of Aries, unto that degree and minute of the Equinoctiall, which ascendeth together with the starr. And note by the way, that 15 degrees of the Equinoctall do make an houre, and foure do make one degree of the Equinoctiall: for foure times 15 do make 60 minutes, which is an houre. Againe, every ascention considered according to the time of his gate, is either right, oblique, or meane: if it be right, it is slow: if it be oblique, it is quick: if it be meane, it is equall. Now the ascention of any Ark or portion

of a Circle is also either right, oblique, or meane: if it be right, it ascendeth slowly: if oblique, it ascendeth quickly: if meane, it ascendeth equally. And the better to understand all these three kinds of ascentions, I will set downe these twelve Rules here following, whereof five do belong to the right Spheare, and seven to the oblique.

1 In the right Spheare all the foure quarters rising from the foure principall points, have a meane ascention, and so hath all the foure points themselves.

2 In the right Spheare all those Signes that be equally distant from the foure principall points, have equall ascentions.

3 In the right Spheare all starres or points that bee in the Solsticiall Colure have meane ascention.

4 In the right Spheare those Signes that do ascend rightly, do descend rightly, and those that do ascend obliquely, do descend obliquely.

5 In the right Spheare, Gemini, Cancer, Sagittarius, and Capricornus, do ascend rightly, and all the rest obliquely.

6 In the oblique Spheare, the two Equinoctiall points have meane ascention.

7 In the oblique Spheare, each halfe of the Spheare, beginning at either of the Equinoxes, have meane ascention: but this Rule holdeth not, if that you begin any other where.

8 In the oblique Spheare, those Signes that no ascend rightly, do descend obliquely, and those which do ascend obliquely do descend rightly.

9 In the oblique Spheare, the ascention of any supposed Signe is equall to the descention of his opposite Signe, and the descention of any supposed Signe is equall to the ascention of his opposite Signe.

10 In the oblique Spheare, the ascention of any Signe being added to his descention, is equall to the ascention and descention of the same Signe being in the right Spheare.

11 In the oblique Spheare, every two Signes equally distant from the two points of the Equinoctiall, have equall ascentions and descentions.

12 In the oblique Spheare under the Pole Arctique, all

Signes

Signes from Cancer to Capricorne, do ascend rightly, and al the rest obliquely, but contrariwise under the Pole Antarctique.

What is the chiefe cause of the diversity of ascentions and descentions, as well in the right as in the oblique Spheare?

The chiefe cause is the diversity of the angles, which the Zodiaque maketh with the Horizon: for the sharper that the angles be, the lesser portion of the Equinoctiall riseth together with the Ecliptique, & the righter that the angles be, the greater portion of the Equinoctiall riseth; but the Equinoctiall by reason of his uniformity, maketh his angles alwayes equall one to another, that is to say, in the right Spheare, it maketh right angles, and in the oblique Spheare, though not right, yet in every Signe it maketh like angles.

Chap. XXXIII.

How to know the diversities of the ascentions and descentions, as well in the right as oblique Spheare.

That is to be knowne most exactly by the Tables of ascentions calculated of purpose by Iohannes do Monte Regio, & by Reinholdus called in Latine Tabulæ directionum, and you may know it also without having respect to every minute by marking and observing the same in a materiall Spheare or Globe, that hath a standing foot with a firme Horizon: for if you will know the diversities of ascentions in a right Spheare, then you must lay the Spheare or Globe so as the Horizon may passe thorow both the Poles, and in turning about with your hand the Equinoctiall, together with the Ecliptique from East to West, marke with what degrée of the Equinoctiall any Signe beginneth to ascend; and marke that degrée of the Equinoctiall with a little pæce of wax: then turne the Globe or Spheare towards the West, untill the last degrée of the said Signe do appeare just with the upper edge of the Horizon, and then marke what degrée of the Equi-

noctiall is answerable to the said last degrée of the foresaid Signe, & there set another pæce of wax: then count the degrées of the Equinoctiall contayned betwixt those two marks: & if it be more than 30, that Signe is said to ascend rightly, if it be lesse than 30, then that Signe ascendeth obliquely, if it be just 30, then it hath a meane ascention; and by allowing 15 degrées of the Equinoctiall to an houre, and 4′ to a degrée, you shall know in what time that Signe riseth. As for example, if you would know what ascention the whole signe Taurus hath in a right Spheare, and also in what time it riseth, do thus: First lay both the Poles of the Spheare just upon the Horizon, so as the same Horizon may passe thorow both the Poles, then bring the first point of Taurus to the East part of the Horizon, so as it may touch the upper brimme or edge of the Horizon, and staying it there with your hand, looke what degrée of the Equinoctiall doth also touch the Horizon at that instant, which you shall finde to be 27 degrées, 54′, and marke that degrée of the Equinoctiall with a little pæce of Wax, or some other thing that may bee easily put out or taken away: that done, put forward the foresaid Signe Taurus still towards the West, untill the last degrée of the said Signe be ascended up even to the upper edge of the Horizon, and there staying it with your hand, looke againe what degrée of the Equinoctiall doth rise withall, which you shall finde to be 57 degrées, 48′, and there set another marke upon the Equinoctiall: then by telling the degrées contayned in the Equinoctiall betwixt the two markes, you shall finde the number of degrées to be 29 degrées, 54′, and by allowing fifteene degrées to one houre, and 4′ to a degrée, you shall finde that the whole Signe Taurus spendeth in his rising one houre, 59′, 36″. But now sith the Meridian in any place (as hath beene said before) doth always shew the right ascention of any starre, Signe, Arke, or point, because that cutteth both the Equinoctiall and the Horizon with right angles: you may therefore finde the right ascention of the said Signe, or of any other Signe or Star, without removing the Spheare from your owne elevation, or latitude in this manner following. Bring the first degrée of Taurus close to the movable Meridian, and there staying it,

marke

marke what degrée of the Equinoctiall the Meridian cutteth at that prefent, which you shall finde to be 27 degrées, 54′, which is the right aſcention of the firſt point of Taurus: then having brought the laſt point of Taurus to the foreſaid Meridian, marke what degrée of the Equinoctiall the ſaid Meridian cutteth at that preſent, and you ſhall finde it to bee the 57 degrées, 48′, now by counting upon the Equinoctiall the degrées contayned betwixt thoſe two markes, you ſhall finde the number to bee 29 degrées, 54′, and you may finde the ſelfe-ſame number by ſubtracting the right aſcention of the firſt point of Taurus, out of the right aſcention of the laſt point of Taurus, and thereby you ſhall know the time of his riſing to bee the ſame that you found in the right Spheare. Now if you would know the aſcention of any Signe in an oblique Spheare, then having placed your Spheare according to your latitude, which for example ſake ſuppoſe to be two and fifty degrées, and that in ſuch latitude you would know what aſcention the whole Signe Taurus hath, and in what time he riſeth, you muſt firſt bring the firſt degrée of Taurus to the Eaſt part of the Horizon, ſo as it may meet even with the upper edge of the Horizon: and there ſtaying it, marke what degrée of the Equinoctiall riſeth therewith, which you ſhall finde to be twelve degrées, 48′, and having marked that degrée, put forward the foreſaid Signe Taurus towards the Weſt, untill the laſt degrée thereof be aſcended up to the upper edge of the Horizon, and then make another marke upon the point of the Equinoctiall, which riſeth at that inſtant with the laſt degrée of Taurus, which you ſhall finde to be 29 degrées, 42′, and by counting the degrées contayned in the Equinoctiall betwixt the two markes, or by taking the leſſer aſcention out of the greater, you ſhall finde the number of degrées to bee 16 and 54′, whereby you may conclude that the aſcention of Taurus in that latitude is oblique, and that he ſpendeth in his riſing one whole houre, 7′, 36″. And looke what order is here taught to finde out the aſcention of any Signe, the ſame order is to bee obſerved for the finding out of the deſcention of any Signe, ſaving that you muſt ſeeke for the deſcention of any Signe, in the Weſt part of the Horizon of the

Spheare

Spheare or Globe, and not in the East part. As for example, if you would know what descention Taurus hath, and in what time hee descendeth in the foresaid latitude: here having brought the first degree of Taurus to the West part of the Horizon, so as it may touch the upper edge thereof, and having also marked what point or degree of the Equinoctiall toucheth the same Horizon at that instant, which you shall finde to bee two and forty degrees, 30', cease not to turne the Spheare or Globe, until all the whole Signe of Taurus be descended under the Horizon, and that the last degree thereof do meet just with the upper edge of the Horizon, and there stay it until you have again marked that point of the Equinoctiall, which toucheth the Horizon at that instant, which you shall finde to be eighty foure degrees, 54', and by counting the degrees contayned betwixt the two markes on the Equinoctiall, you shall finde the number of degrees to be two and forty degrees, 24', so as you may conclude, that the descention of Taurus in that latitude is right, and that he spendeth in his going downe two houres, 48'.

How shall I know the right or oblique ascention of any of the fixed starres, and also at what houre of the day or night they rise and set, and how long they abide above the Horizon? finally when they are at the highest, and when they are at the lowest, called the depression or lowest Meridian Altitude of the starres?

All these things are most truly knowne by Tables, calculated of purpose, and also they are to be knowne by helpe of the Celestiall Globe, in such manner as shall be declared hereafter, when we come to treat of the said Globe.

CHAP.

Chap. XXXIII.

Of the aſcentionall difference and uſes thereof.

What is the aſcentionall difference?

It is a portion of the Equinoctiall, whereby is knowne how much the right aſcention and oblique aſention of any ſtar, or portion of the Ecliptique line, or any other point in the firmament, doth differ one from another. As for example, in that place where the Pole is elevated two and fifty degrees, and the declination eleven degrees, 32', the right aſcention of the firſt point of Taurus, is ſeven and twenty degrees, and 54', and the oblique aſcention of the ſame point is twelve degrees, 48', here by taking the leſſer out of the greater, that is, twelve degrees, 48', out of ſeven and twenty degrees, and 54', there will remayne fiftene degrees, and 6', which is the aſcentionall difference.

What uſes hath the aſcentionall difference?

The aſcentionall difference being knowne, all the oblique aſcentions and deſcentions of the ſtarres are eaſily knowne by the Tables of Directions: again, by this difference is knowne the encreaſe and decreaſe of the artificiall day in every latitude: and therefore it is called of ſome incrementum diei. Moreover, it ſheweth the ſemidiurnall Arke of the artificiall day, for in every oblique Speare, the artificiall day is allwayes either longer or ſhorter, than the Equinoctiall day throughout the yere, unleſſe the Sun be in either of the Equinoctiall points.

How is the encreaſe or decreaſe of the day, to be knowne by the aſcentionall difference?

That ſhall be declared hereafter in the fiftieth Chapter of this firſt Booke, whereas wee treat of the artificiall day and night. In the meane time we will ſpeake ſomewhat of the Poeticall riſing and ſetting of the Starres.

Chap.

Chap. XXXV.

Of the Poeticall rising and setting of the starres.



Define what the Poeticall rising and setting is?

The Poeticall rising is the appearing of some starre above the Horizon, determined by the Sunne: and the Poeticall setting, is either the going downe of some starre under the Horizon, or else the hiding thereof under the beames of the Sunne.

How manifold is the Poeticall rising and setting?

Threefold, that is Cosmicus, Acronicus, and Heliacus: the signification of which words shall appeare unto you by the definitions of the foresaid three kinds here following. For ortus Cosmicus, called in Latine mundanus, which is as much to say here as the worldly or morning rising, is when any starre riseth in the morning above the Horizon, together with the Sunne, or rather with that point of the Ecliptique line wherein the Sun is at that time. And the Cosmicall setting, called in Latin occasus Cosmicus, is when a starre goeth downe under the Horizon at such time as the Sunne riseth, so as this kind of rising and setting is wholly to be referred to the rising of the Sun.

What is *ortus* and *occasus Acronicus*?

Ortus Acronicus, which is as much to say as the evening or temporall rising, is when any starre riseth above the Horizon in the evening at the going downe of the Sunne: And occasus Acronicus, that is to say, the evening setting, is when any star goeth downe under the Horizon, together with the Sunne, and therefore this kind is allwayes to be referred to the going down of the Sunne, and not to his rising: and whatsoever Signe or starre doth rise Acronicè, the same goeth downe Cosmicè, and whatsoever starre doth rise Cosmicè, the same goeth downe Acronicè. And generally all starres that rise in the day-time, are said to rise Cosmicè, and all those that rise in the evening after the Sunne set, are said to rise Acronicè.

What

What is *ortus & occasus Heliacus?*

Ortus Heliacus, that is to say, the Solar rising, is when any ſtarre by departing from the beames of the Sunne appeareth, and may bee ſeene, which before being darkned by the Sunne could not bee ſeene. And occaſus Heliacus, is when any ſtarre by the nigh approaching of the Sunne ceaſeth to be ſeene, for by reaſon that the Sunne by his yerely courſe and oblique motion of the Ecliptique, doth ſometime approch to divers ſtarres, and ſometime by little and little, retireth backe againe from the ſame, it falleth out that thoſe ſtars to whom he approcheth, are by nighneſſe of his great light, darkened and not ſeene, and by his departing from them, and eſpecially when the Sunne is in the Eaſt or Weſt part of the firmament, they begin againe to be ſeene. And therefore as in the other two kinds, the Horizon together with the riſing and ſetting of the Sunne, are to be conſidered as chiefe cauſes thereof, ſo in this laſt kind the chiefe cauſe is to be referred to the nighneſſe or farneſſe of the Sunne from the ſtarre.

Whereto ſerveth the knowledge of this three-fold Poeticall riſing and ſetting of the ſtarres.

It ſerveth chiefly to underſtand thereby thoſe Poets and Hiſtoriographers, which in ſhewing the time of any Act done or to be done, do not ſet downe the day of the month, but are wont to deſcribe the time by the riſing or ſetting of ſome notable ſtarre, which they thinke moſt mèt for their purpoſe, and thereby do greatly adorne their ſtile, and ſpecially being Poeticall: And becauſe that the times wherein ſuch ſtars did riſe or ſet, do greatly differ in theſe dayes from the ancient times. Many therefore of our moderne writers, as Garceus and others, have made divers Tables of purpoſe to finde out the difference, and thereby to come to the true knowledge of the times by the ancient men deſcribed: of which matter I leave to ſpeake, thinking it not mèt to trouble yong Saylers therewith, for whom I chiefly wrote this Treatiſe of the Spheare.

Yet ſome affirme that the ancient men did uſe the foreſaid Poeticall riſing and ſetting of certayne ſtarres, and ſpecially of

the

the *Pleiades*, *Hiades*, *Orion*, *Arcturus*, *Capella*, and *Lyra* (which ſtarres were to them beſt knowne) as a Kalender, not only to know thereby the difference of times and ſeaſons of the yeere: but alſo by their manner of riſing, ſetting, hiding, and appearing, to prognoſticate and to fore-ſee tempeſts and ſtormes, yea and that in theſe dayes we alſo (as ſome write) might do the like, though there were neither Kalender nor Ephemerides, and in that reſpect the knowledge hereof ſeemeth moſt neceſſary for Mariners.

All ſuch things are to be knowne more exactly by the Aſtronomicall aſcention and deſcention, than by the Poeticall riſing or ſetting of the ſtarres. And you have to underſtand that the ſtars ſince thoſe dayes have changed their places, their longitudes, and declinations, and thereby in divers reſpects have altered their natures and qualities, yea, and the very Signes themſelves: As for example, neither Taurus, Gemini, nor Cancer, is ſo hot and dry now, as in times paſt, neither doth Scorpio cauſe ſo much thunder now, as in times paſt: ſome againe are more vnleſſe cold and moyſt than they have bene heretofore, the cauſes whereof I leave to the diſcuſſing of the Aſtrologers, and ſo once againe end with this matter.

Chap. XXXVI.

Of Time, what it is, and into what parts it is divided.

MOſt men that write of the Spheare, after they have ſpoken of the aſcentions, do immediatly treat of the diverſity and inequality of dayes and nights: but ſith dayes, nights, and houres, are but parts of Time, like as be Weeks, Months, and Yeares, I mind here therefore, firſt briefly to treat of Time, and then of all his chiefeſt parts in order: for if you will be inſtructed at large of theſe matters, then read the Booke of Iohannes de Sacro-boſco de anni ratione, and Iohannes Garceus his Booke de tempore.

How define you Time?

Leaving

Leauing to speak of Time, without Time, that is to say, everlasting and infinite, called of the Latines Eternitas, ascribed chiefly to God, and therefore not contayned within the mouable Spheares or Heauens: I mind to speake here only of that Time, which is a number measuring the moving of the first mouable, and of all other mutable things, which Time had his beginning with the world, and shall end with the same: and this Time consisteth of two parts, that is, first and last, or rather before or after, successively following one another, and these two parts are knit together with a common band, called of the Latines Nunc, that is to say, now, or at this present, which is the end of that which went before, and the beginning of that which followeth after; and therefore some do diuide Time into three parts, that is, Time past, Time present, and Time to come; but the Time present is a moment indiuisible, and is the beginning of Time, euen as a point or prick is the beginning of all Magnitudes, and yet the least part thereof it selfe: Again, Time is diuided of some into greater or lesser parts; the greater are such as these: Kalends, Nones, Ides, a Weeke, a Month, a Yeare, the space of fiue yeares, called of the Romans, Lustrum, and of the Greekes, Olympias, the Romans did call it Lustrum, à lustrando, that is to say, of going about, becau'se that they used in the end of every fiue yeares, with lights and torches of Wax to go in procession round about the City, and did purge the same by sacrificing a Dogge, a Sow, an Ore, and at that time also they did chuse their Dictator, in a place called the field of Mars, but the space of fiue yeares called Olympias, toke his name of the high mount Olympus in Greece, whereas in the end of every fiue yeares were celebrated all kind of martial playes, as Fencing, Wrestling, Running, and such like, in the honour of Iupiter Olympius, also the space of fiftene yeares, called Indictio, in which place those foren Nations that dwelt far off, and were tributary to the Romane Empire, paid their Tributes: that is to say, In the first fiue yeares, they paid only gold, in token of their obedience to the Empire: In the second fiue yeares, they payd siluer for Souldiers wages, and in the last fiue yeares, they payd braſſe towards the reparation of armour

and

and munition. Item, the ſpace of an hundred yéares, called in Latine ſeculum, and in Engliſh an age, whereof the playes that were celebrated in Rome every hundred yeare, were called Ludi ſeculares; and laſt of all, the ſpace of a thouſand yéares, called ævum, containing ten ages: Againe, the leſſer parts (as Iohannes de Sacro-Boſco ſaith) are theſe five, the firſt is called in Latine quadrans, which is the fourth part of a day, that is, ſix houres: the ſecond punctus, which is the fourth part of an houre in the Sunnes account, but in the Moones account the fifth part of an houre: the third is called momentum; which is the tenth part of punctus: the fourth is called uncia, which is the twelfth part of momentum: the fifth is called Atomus, which is the eight and fortieth part of uncia: But becauſe in all the greater parts of Time there is no greater variation or difference, than in that which in Latine is called annus, and in Engliſh a yéare: I mind here therefore firſt to treat of a yéare, and then of months, wéeks, dayes, nights, and houres.

Chap. XXXVII.

Of the yeere, and of his divers kinds, and of the divers computations had thereof in divers ages, and amongſt divers Nations.

BE there divers kinds of differences of yeeres?

Yea, indéed, but I will ſpeake here only of three kinds of differences, that is, of the great yéare, the Solar yéare, and the Lunar yéare, whereof the two laſt are moſt neceſſary for our purpoſe.

What is the great yeere?

The great yéare is a ſpace of time in the which not only all the Planets, but alſo all the fixed ſtarres that are in the firmament, having ended all their revolutions, do returne againe to the ſelfe-ſame places in the heavens, which they had at the firſt beginning of the world: and therefore it is called of ſome the yéare of the world, and of ſome the great yéare of Plato, which con-

containeth according to Alphonsus 49000 yeares, whereof we have spoken before, yet some affirme that the perfect yere of the world containeth but 36000 yeeres, whose revolution is after one degree in 100 yeres: but leaving this matter as not greatly profitable, we will speake now of the yere Solar.

Chap. XXXI.

Of the Sunnes yeere, called in Latine annus Solaris, *and of the divers kinds thereof, and first of the Tropicall yeere, both equall and unequall.*

WHat is the yeere Solar?

It is that space of time in which the Sunne departing from any point of the Ecliptique line, or from some fixed Starre of the Zodiaque, goeth round about the Zodiaque by his owne proper moving, which is from West to East, and so returneth againe to the selfe same point or starre from which he first departed, and the Astronomers doe make divers divisions of the Solar yere, for first they say, that it is either Astronomicall or Politicall: Secondly, that the Astronomicall yeere is either Tropicall or Syderall: Thirdly, that the Tropicall is either equall or unequall, which unequall yeere they otherwise call the apparant yeere and true yeere, all which kinds have in a manner one selfe definition, saving that the Tropicall yeere taketh his beginning from the vernall Equinoctiall point, and the Syderall yeere from the former Starre of the Ramshorne, and do differ chiefly in quantity.

Shew then what quantity, that is to say, how many daies, houres, and minutes every such yeere containeth.

The equall Tropicall yeere being counted alwaies from the point of the vernall Equinore, containeth 365 daies, five houres, 49′, 15″, and 46‴. But the unequall or apparant Tropicall yeere containeth sometime more and sometime lesse than the equall yeere, for sometime besides 365 daies and five houres,

it amounteth to 56′, 53″, and 1‴, so as it is more then the equall Tropicall yeare by 7′, 37″, & 15‴ and sometime over and besides the foresaid 365 daies and five houres, it only containeth 42′ 38″, and 27‴ which is lesse then the equall Tropicall yeare by 6′, and 3″, which unequality chiefly chanceth by reason of the unequall procession of the two Equinoctiall points, before defined in the six and twentieth Chapter.

Chap. XXXIX.

Of the Syderall yeere, and how much it containeth

WHat is the Syderall yeere?

The Syderall or Starrie yeere is that space of time wherein the Sunne walking under the firmament, departeth from the first or foremost Starre of the Rammes horne, and returneth to the same Starre againe, which space of time alwaies and equally containeth 365 daies, six houres, 9′, and 39″, so as this yeare is alwaies greater then the Tropicall yeare, and by his equality doth alwaies rule and rectifie the inequality of the Tropicall yeare.

Chap. XL.

Of the Politicall yeere, and divers kinds thereof.

WHat is the Politicall yeere?

It is a yearely space of time which any people or nation attributeth to the course of the Sunne, or of the Moone, or of either of them, which is divers and manifold, according to the divers customes of the nations, of all which I meane not to speake at this present particularly, but of certaine speciall and necessary to be knowne, as of the Julian yeare, of the Egyptian yeere, of the Jewes yeare, and of the Athenian yeare.

Chap.

Chap. XLI.

Of the Iulian yeere, and why it is ſo called.

WHat is the Iulian yeere?

The Julian yære is that which wé uſe at this preſent day, which of all other yæres draweth nigheſt unto the Tropicall yére: for this yære conſiſteth of 365 daies and ſixe houres, which ſix houres, if it ſhould be reckoned every yære, it would make a great confuſion, and therefore it is reckoned at the end of every fourth yére, which yére conſiſteth of 366 daies, for foure times ſix doth make foure and twenty houres, which is one whole naturall day, whereof that yære is called the leape yére: and thereby the Julian yære is ſaid to bée twofold, that is common, containing 365 daies, and the other Biſſextile or leape yére, containing 366 daies. This word Biſſextile, is derived of bis and ſextus, becauſe the ſixth day next before the Kalends of March is twice repeated or reckoned, which in déed is the ſixe and twentieth of February, upon which day the feaſt of Saint Matthias commonly falleth.

Why was it called the Iulian yeere.

Becauſe Iulius Cæſar the firſt Monarch of the Romane Empire cauſed the yére (according to the courſe of the Sun) to bé reduced to the number of daies and houres before expreſſed, who brought an excellent Aſtronomer with him at his coming from Egypt, as well for that purpoſe, as to teach the Mathematicall diſciplines unto the Romans: yet you haue to conſider that the Julian yeere being greater then the Tropicall yeere, doth cauſe great diverſity, in that it maketh as well the Equinoctiall and Solſticiall points, as alſo the entrance of the Sunne into the other ſignes by little and little to anticipate or to runne before, for whereas in Iulius Cæſars time the vernall Equinox was the three and twentieth day of March, the ſame Equinox is now about the eleventh day of March, which is ſooner by twelue daies.

Chap. XLII.

Of the Egyptian yeere, and how many daies it containeth.

The Egyptian yeere containeth the iuſt number of 365 daies, by reaſon of which equality this yeere is very fit to ſerue the Aſtronomers turne in making their Aſtronomicall computations, but the Egyptian yære hath no certaine place of beginning: For by omitting the ſix houres which is in the Julian yære, it doth anticipate in the ſpace of foure yéres one whole day, in ſuch ſort as 1460 Julian yæres do make of the Egyptian yæres, 1461.

Chap. XLIII.

How many Moones the Iewes yeere, and the Athenians yeere doth containe.

The Iewes yære containeth for the moſt part twelue Moones, and ſometimes thirténe Moons, which kind of yæres did agrée with the yæres of the Greekes and of the Athenians, and alſo of the ancient Romanes before Iulius Cæſars time: and the ancient Romanes did begin their yære from March, but the later Romanes from the winter Solſtice: Againe, the Iewes did begin their yære at the firſt new Moone that followed next after the vernall Equinox: But the Athenians began their yære at the new Moone that followed next after the Summer Solſtice: the moſt people of Aſia began their yære at the Autumnall Equinox: But the moſt part of thoſe that dwell in theſe parts of the World, following the cuſtome of the Romane Church, doe beginne their yeere at the Kalends of Ianuary, which in old time was not much diſtant from the Winter Solſtice, which Solſtice at Chriſts

birth was the five and twentieth of December, but now the same Solstice is about the twelfth day of December, so as the Winter Solstice falleth sooner by thirtéene daies then it did at that time. But wée héere in England doe begin the yéere at the five and twentieth of March.

CHAP. XLIIII.

Of the yeere Lunar, and of the kinds thereof.

HOw many kindes of Lunar yeeres bee there, and which they be?

Of Lunar yéeres there be two kinds, whereof the one is ordinary, called in Latine Annus communis, and the other extraordinary or excessive, called by a Greeke name Emboliſmalis, the ordinarie or common yéere, is the space of twelue Moones or changes, passing by course within the yéere Solar, and is called Common, because it hath twelue months Lunar, even as the Solar yéere hath twelue months Solar, and consisteth of 354 daies and a little more, so as the Solar yéere exceedeth the Lunar yéere by eleuen daies, for the yéere Solar containeth (as hath béene said before) 365 daies, in which account the fractions in both yéeres are omitted: and therefore if these two yéeres should begin together at one selfe time, the Lunar yéere would end his course sooner by eleuen daies then the yéere Solar.

What is the extraordinarie Lunar yeere called Emboliſmalis.

It is the space of thirtéene Moones or changes containing 384 daies, so as this yéere exceedeth the common Lunar yeere by thirtie daies, and is more then the yeere Solar by nineteene dayes.

Chap. XLV.

Of the divers kinds of months, and into what parts every Solar month is divided according to the Romanes, that is, into Kalends, Nones, and Ides.

How many kinds of months be there, and which bee they?

There be three kinds, that is, the month Solar, the month Lunar, and the month Vsuall.

The month Solar is that space of time which the Sunne spendeth in passing through any one of the twelve signes.

The Lunar month is that space of time which the Moone spendeth while she departing from the Sunne, returneth to him againe.

The Vsuall month is that number of dates which are set downe in our common Kalenders, whereof some containe thirty dates, some three and one, and the month of February hath but eight and twenty dates. But if you will readily know which containe more dates, and which lesse, keepe in memory the two English verses here following.

Thirty dates hath November,
April, June, and September:
February hath twenty eight alone,
And all the rest hath thirty and one.

But when it is leape yeare, February hathnine and twenty dates. Againe, the Romanes divided the Solar month into Kalends, Nones, and Ides.

What be Kalends?

The Kalends are the first day of every month, from which the Romanes counted the dates of the month proceeding backward: as for example, the first day of Aprill they named the Kalends of Aprill, and the last day of March next before they called in Latine pridie Kalendas Aprilis, that is, the day before the Kalends of Aprill, and the next day before that the third Kalends

lends of Aprill, and the next day before that the fourth Kalends and so forth vntill they come to the Ides.

Whereof sprang this name Kalends?

Of the Greeke verb Calo, which is as much to say as call, for the first day of every month the Cryar standing in an high place, made foure calles or more, to signifie thereby to the people how many daies in that month the Faires or markets called Nundinæ should endure, and of Nundinæ sprang this word Nonæ, that is to say, the dayes of the Faires: for looke how many Nones there were in every moneth, so many Faires there were, during which time the Romans never worshipped any God, because there was no holy day during that time, and therefore Ovid saith that Nonarum tutela Deo caret, that is to say, no God hath tuition of the Nones.

What are Ides?

They are those daies by which the Nones are divided from the rest, and these Ides doe divide in a manner the whole month into two equall parts, for the first Ides most commonly falleth either on the thirteenth, fourteenth, or fifteenth day of the month.

How many Ides, Nones, and Kalends doe belong to every month?

Of Ides every month hath eight, but of Nones, March, May, July, and October, have six, and all the rest of the months have but foure Nones, but they differ most in the number of Kalends, as you may perceive by this Table following, which sheweth how many Kalends, Ides, and Nones, doe belong to every month. Thus far of the month Solar, now I will speake of the month Lunar.

The Table.

Months.	Kalend.	Idus	Nones.	Months.	Kal.	Idus.	Nones.
Ianuary.	19	8	4	July.	17	8	6
Februarie.	16	8	4	August.	19	8	4
March.	17	8	6	Septem.	18	8	4
Aprill.	18	8	4	October	17	8	6
May.	17	8	6	Novem.	18	8	4
Iune.	18	8	4	Decem.	19	8	4

CHAP. XLVI.

Of the divers kinds of months Lunar.

HOw many kinds be there, and which be they? Iohannes de sacro Bosco, saith that there be foure kinds, that is, the month of Paragration, the month of Apparition, the month Medicinall, and the month of Consecution.

The month of Paragration, is that space of time in which the Moone departing from any one point of the Zodiaque goeth by her proper moving about the Zodiaque and returneth againe to the said point from which she first departed, which her revolution is accomplished in seven and twenty daies and eight houres, and this revolution of some is called a yere, and by this account the Moone tarrieth in every signe two daies six houres, and 29 minutes.

The month of Apparition consisteth of eight and twenty daies, divided commonly by foure wækes, every wæke containing seven daies, for foure times seven maketh eight and twenty, of which foure wækes the first is counted from her first apparance unto the end of the seventh day, and so forth from wæk to wæk, so as the fourth wæke endeth at the eight and twentieth day, in which account the odde houres during the Moones abode under

the

the beames of the Sunne, when as she is said to be combust, are not reckoned.

The moneth Medicinal containeth but six and twenty daies and a halfe (as Galen saith) and is divided also into foure weekes, the division being made by minutes.

The moneth of Consecution is that space of time wherein the Moone being in conjunction with the Sunne goeth about her Circle and returneth againe to the same point, and not finding the Sunne there, because he hath in that while passed thorow one whole signe, she hasteth after, and in two daies and foure houres 44' and a little more she overtaketh the Sunne, and is againe with him in conjunction, of which her following and overtaking the Sunne, this moneth is called the moneth of Consecution, which moneth consisteth of nine and twenty daies and a halfe: during which time as the Sunne by his owne proper course passeth thorow one signe or thereabouts, so the Moone by her course in the selfe same time passeth thorow the whole Zodiaque and one signe more: And note by the way, that the Sun in making his owne proper course doth not enter into any signe in the very beginning of any moneth, but rather about the middest of every moneth, or at the least not much over or under that day.

Chap. XLVII.

Of a Weeke.

NOw because that every moneth as well Solar as Lunar is divided into foure weeks, I will speak some what of a weeke.

What is a weeke?

A weeke, called most commonly in Latine Septimana, which is as much to say, as seven mornings, is the space of seven daies, whereof the first is called Sunday, the second Munday, and so forth to Saturday, which names the Gentiles gave to these seven daies in honour of the seven Planets, whom they worshipped as Gods,

Gods, for they called the first day the day of the Sunne, the second the day of the Moone, the third the day of Mars, the fourth the day of Mercury, the fifth the day of Iupiter, the sixth day of Venus, the seventh the day of Saturne.

Are there any more names belonging to this word weeke?

Yea, it is called also by a Greeke name Hebdoma, that is to say, containing seven daies, and in the Scripture it is called sometime Sabbatum, as when the Pharisie said that he fasted Bis in Sabbato, that is to say, twice a weeke, for the Iewes called Sunday the first of the Sabbath, and Munday the second of the Sabbath, and so forth in order until Saturday, which indeed was their true Sabbath or day of rest.

Why is it not still so counted amongst us Christians, but changed into Sunday?

For two causes, first to avoid the superstition of the Iewes, and partly it was done in the honour of Christ, whose day of Birth, Resurrection, and sending of the holy Ghost, was on the Sunday.

Chap. XLVIII.

Of daies and nights both naturall and artificiall

The Astronomers doe divide the daies into two kindes, whereof the one is called naturall, and the other artificiall.

What call you a naturall day?

A naturall day is one entire revolution of the Equinoctiall about the Earth, whereunto must be added such portion of the Zodiaque, as the Sunne in the meane while maketh by his proper motion, which is from West to East.

In what time doth the Equinoctiall every day make his revolution?

In foure and twenty houres, which space containeth both day and night, according to which revolution and number of houres

houres, the moſt part of Horologies or clocks in the Eaſt country do goe, and are ſet to ſhew the houres of the day, but yet diverſly, for ſome beginne their naturall day, at the riſing of the Sunne, as the Bohemians and the Perſians, and ſome at the going downe of the Sun, as the Italians, the Athenians, the Iewes, the Egyptians, and the Arabians, but the Aſtronomers reckon their naturall day from noonetide to noonetide.

If the Equinoctiall doth make his revolution juſt in foure and twenty houres, then all naturall daies are equall.

That is true, if ye only conſider the motion of the Equinoctiall, but if you adde thereunto (as I ſaid before) that portion which the Sunne in the meane while maketh by his owne proper motion, you ſhall finde them to be unequall, becauſe that portion is ſometime more, ſometime leſſe, according to the ſwift or ſlow aſcention of the ſigne, wherein the Sunne is.

What is the artificiall day?

It is the diſtance or ſpace that is betwixt the riſing of the Sun and going downe of the ſame.

CHAP. XLIX.

The cauſes why the time betwixt the riſing and going downe of the Sunne is unequall.

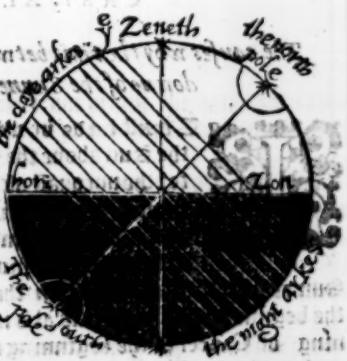
IT muſt needs be unequall, becauſe the abode of the Sun above the Horizon is variable, as well for the unequall aſcention and deſcention of the ſignes, as alſo for the obliquity of the Horizon and Zodiaque: and therefore the ſpaces of the artificiall daies muſt needs be unequall: for the Sun as well in aſcending from the beginning of Capricorne, to the beginning of Cancer, as alſo in deſcending from the beginning of Cancer to the beginning of Capricorne, deſcribeth on each part 182 Circles or Parallels, the middlemoſt whereof is the Equinoctiall. All which Parallels are divided into two parts by the Horizon, and the Arkes which are above the Horizon

rizon are called the artificiall dayes, and the Arkes beneath the Horizon are called the artificiall nights, which Arkes to those that dwell under the Equinoctiall in a right Spheare are alwayes equall, that is to say, the diurnall Arke is equall to the nocturnall, because their Horizon passeth thorow the Poles of the World, but to those that dwell in an oblique Spheare above whose Horizon the Pole is any thing elevated, be it never so little, the Arches or Parallells are unequall one to another, that is to say, either making short dayes and long nights, or else long dayes and short nights, the Equinoctiall only excepted, which as well in the oblique Spheare as in the right, is alwayes divided by the Horizon into two equall parts, and so maketh the dayes and nights equall in all places of the World. All which things you may easily comprehend by these two Figures following, whereof that on the left hand representeth the right Spheare, and the other on the right hand representeth the oblique Spheare.

A figure of the right Spheare.



A figure of the oblique Spheare.



And here I thinke it not amisse to shew you how to find out the length of every artificiall day and night thorowout the yeare in every latitude by the materiall Spheare, and likewise

wise how to know at what part of the Horizon the Sunne riseth and setteth every day, and also how to find out his Meridian Altitude, whereby you shall know how nigh or how farre from your Zenith he is every day.

Chap. L.

How to find out by the materiall Spheare or Globe, and by help of the ascentionall difference before defined, the encrease and decrease of every day thorowout the yeere in every severall latitude, and at what houre the Sunne riseth and setteth.

FIrst having set the Spheare at your latitude, learne to know by some Table or Instrument in what signe and degree thereof the Sun is at such day of the month and yeere as you take, and bring that degree close to the moveable Meridian, and there mark in what point or degree the said Meridian cutteth the Equinoctiall, and what number it hath, for so shall you have the right ascention of the degree of the Sunne for that day. That done, bring the said degree of the Sun to the East part of the Horizon, so as it may meete even with the upper edge thereof, and staying it there, mark what Degree of the Equinoctiall at that instant doth also touch the Horizon, and what number it hath, and that is the oblique ascention of the foresaid degree of the Sunne, then subtract the lesser number out of the greater, and that which remaineth shall be the ascentionall difference, as for example, in this present yeere 1590. the eleventh day of Aprill the Sunne is in the first degree of Taurus, whose right ascention in the Latitude two and fiftie, by doing as before is taught, you shall find to be seven and twenty degrees and 54′, and the oblique ascention thereof to be twelve degrees, 48′, and the ascentionall difference to be fifteene degrees, 6′, which difference you must first double, and then convert the same into houres and minutes, by allowing fifteene degrees to an houre, and 4′ to a degree, that done, adde

those

those houres and minutes to the Equinoctiall day, which is alwayes twelue houres, and the summe of that addition will shew you the length of the day, when the Sunne is in the first point of Taurus, which is fourteene houres and 12', and that is the true length of the day. But you have to note by the way, that as you have to adde the summe of the houres to the Equinoctiall day, the Sun being in any of the six Northerne signes, so must you subtract the said houres from the Equinoctiall day, the Sun being in any of the six Southerne signes. As for example, suppose the Sun to be in the first point of Scorpio, the right ascention whereof is 207 degrees, 54, and the oblique ascention is 223 degrees: here by taking the lesser out of the greater you shall find the ascentionall difference to bee fifteene degrees, 6', which being doubled, maketh thirty degrees and 12, that is, two houres and 12', which if you subtract from twelue, there will remaine nine houres 48', which is the length of the artificiall day, when the Sunne is in the first degree of Scorpio, the one halfe whereof is called the semidiurnall Arke of that artificiall day, which is foure houres, 54 minutes, whereby you may gather that the Sunne at that time riseth six minutes after seuen of the clocke, and setteth againe six minutes before five: so likewise in the former example, where the ascentionall difference was fifteene degrees, six minutes, which being doubled made thirty degrees and twelue minutes, that was two houres and twelue minutes, which being added to twelue houres, made fourteene houres and twelue minutes, the halfe whereof is seuen houres and six minutes, whereby you may gather that the Sun did then rise six minutes before five of the clocke in the morning, and did set six minutes after seuen of the clocke in the euening, and so you have both the forenoone and afternoone of the day, which two times are best to be reckoned alwayes from twelue a clocke at noone, that is to say, the forenoone houres and minutes from twelue backward, and the afternoone houres and minutes from twelue forward, and by subtracting the whole length of the artificiall day from foure and twentie houres, you shall have the length of the artificiall night, as in the former example, take fourteene houres and twelue minutes from foure

and

and twenty houres, and there will remaine for the length of the artificiall night nine houres and fortyeight minutes.

Chap. LI.

How to know by the materiall Spheare or Globe, in what part of the Horizon the Sunne riseth and setteth every day, and thereby the length of the day. Also how to know the Meridian altitude of the Sunne every day throughout the yeere, and being at his Meridian altitude, to know how farre distant he is from the Zenith every day.

FIrst then having set the Spheare or Globe at your Latitude, which suppose to bee two and fiftie degrees, bring the degree of the Sunne for that day to the East part of the Horizon, so as it may meet just with the upper edge thereof, and there set a little pece of wax upon the Horizon: that done, turne the said degree of the Sunne to the West part of the Horizon, untill it meet againe with the upper edge of the Horizon, and there set another pece of wax upon the Horizon, and those two markes will shew you in what part of the Horizon the Sun riseth and setteth: As for example, I would know this present yere 1594, in what part of the Horizon the Sun doth rise and set the twelfth of June: here finding by the Ephemerides that the Sun is entred 16 into Cancer at that day, I bring that point of the Ecliptique to the East part of the Horizon, so as it may meet just with the upper edge thereof, and there I set a little pece of wax upon the Horizon: that done, I turne the said point of the Ecliptique to the West part of the Horizon, and whereas that point toucheth the upper edge of the said Horizon, I set there another pece of wax upon the Horizon, then counting the degrees upon the Horizon from the true East point thereof to the first pece of wax Northward, I find the number of degrees to be fortie degrees or there a-

bouts,

bouts, which containeth three points and a halfe, and somewhat more, of the Mariners Compasse, whereby I gather that the Sun riseth at that time very neere to the Northeast, and setteth neere to the Northwest, because the number of the degrees in both parts of the Horizon are alike.

How shall I know how many points of the Mariners Compasse are contained in any number of degrees exceeding the number of degrees and minutes contained in one point.

The Mariners Compasse containeth two and thirty points, and every point containeth eleven degrees and $\frac{1}{4}$ of a degree, which is fifteene minutes, wherefore whensoever you would know how many points of the Compasse are contained in any number of degrees, be it great or small, multiply that number by foure, and divide the product thereof by 45, and the quotient will shew the number of the points, and if there were any remainder, then because the Mariner doth make every point to have foure quarters, multiply that remainder by foure, and divide the product by 45, which is the common Divisor, and the quotient will shew the quarters, or if the remainder be but small, then multiply that remainder by eight, which are halfe quarters and divide the product thereof by 45 as before, and the quotient will shew the halfe quarters of a point: as in the former example in multiplying fortie degrees by foure, the product is 160, which if you divide by 45, you shall find in the Quotient three whole points, and the remainder to be twenty five, which being multiplyed by foure, the product will be an hundred, which if you divide by 45 you shall finde in the quotient two quarters of a point, and the remainder to be $\frac{10}{45}$ of a quarter, that is to say, if you can divide one quarter in 45 parts, then you must take ten of those parts, and adde them to the former summe, which being of small importance is not to be regarded. But now to returne to my first matter, I say that by counting the degrees upon the Horizon, from the first peece of war to the South point of the Horizon, I find the number of degrees to be 130 degrees, and by allowing fifteene degrees to an houre, I finde the halfe day to containe eight houres, 10 minutes, which being doubled, maketh fifteene houres 20'. Then to

know

know the Meridian altitude of the Sunne, you must bring the degree of the Sun right under the Meridian, and the number of the degrees contained in the Meridian betwixt the South point of the Horizon, and the said degree of the Sun wil shew the Meridian altitude of the Sunne, so shall you find the Meridian altitude of the Sun being in the first point of Cancer, to be sixtie one degrees, which once had the distance from the Zenith is soone knowne: for if you subtract sixtie one degrees from ninety, you shall find the distance of the Sunne from the Zenith to be nine and twenty degrees. Againe contrariwise the distance of the Zenith being subtracted from ninetie, the remainder will shew the Meridian Altitude, for those two numbers being added together, doe alwaies make a just quarter of the great Circle, which is ninety degrees.

Chap. LII.

Of houres as well equall as unequall, and into what parts they are divided.

AS of daies and nights there be two kinds, that is, naturall and artificiall before defined, so likewise are there two sorts of houres, that is, equall and unequall: an equall houre is the foure and twentieth part of a naturall day, and every such houre containeth fifteene degrees of the Equinoctiall, for fifteene times foure and twenty maketh 360 degrees, which is the whole circuit or Longitude of the Equinoctiall, which according to the diurnall moving of the first moveable, maketh his revolution in foure and twenty houres, as hath beene said before, and therefore this equall houre is also called an Equinoctiall or naturall houre. The unequall houre is the twelfth part of an artificiall day or artificiall night, which daies and nights as they be sometimes long and sometimes short, according to the time of

the yeere, so are the houres of the same. For both day and night, be it never so short, is divided by the Astronomers into twelve houres, so as when here in some part of England towards the North, the artificiall day is seventéne houres long, and the night but seven houres, if you divide either of these into twelve parts, you shall find that every such twelfth part of the day shall containe more then the naturall or Equinoctiall houre by 25', and the twelfth part of the said artificiall night to containe but the one-halfe of an equall houre and five minutes, which notwithstanding being both added together, will make in all foure and twenty equall houres, which is a naturall day: so as by this meanes you may easily perceive that a naturall day comprehendeth both kinds of houres, as well unequall as equall. Note also that the unequall houres are called sometime artificiall, and sometime temporall houres; artificiall, because they are daily changed by the variety of the artificiall daies and nights, and are never equall but twice in the yeare, when the Sunne is in either of the Equinoxes: and they are called temporall, because the ancient observers of time were wont to make divers Clockes and Horologies to shew these unequall and temporall houres, of which Clocks there are yet some to be séene at this day. Moreover, the houres both equall and unequall are divided not only into quarters of houres, but also into minutes: for every houre be it long or short, is divided into sixty minutes, and every minute into sixty secondes, and every second into sixty thirds, and so forth to fourthes, fifthes, sixthes, and into as many as you will, so as you make your division alwaies by sixty. But you have to note, that as the Astronomers doe divide the artificiall day and artificiall night into houres both equall and unequall, so the Iewes doe divide each of them into foure quarters, in manner and forme following.

CHAP.

Chap. LIII.

How and in what manner the Iewes do divide the artificiall day and night, each of them into foure quarters.

They divide the Artificiall day into foure quarters, by allowing to every quarter three houres, accounting the first houre of the first quarter at the rising of the Sun, and the third houre of the said quarter they called the third houre, and the third houre of the second quarter they called the sixth houre, which was midday or noonetide: againe, they called the third houre of the third quarter, the ninth houre, and they called the second houre of the fourth quarter, the eleventh houre, and they called the last houre which was the twelfth houre of the day, eventide, because then the Sun went downe.

Whereto serveth the knowledge hereof.

By knowing this account you may the better understand certaine places of the Scripture making mention of things done at certaine houres not like unto our common houres. For whereas it is said in the Gospell of Saint Iohn, that Christ healed the Rulers sonne that was sicke of an Ague in Capernaum, and that the Ague left him the seventh houre, is as much to say, as the ague left him at one of the clocke in the afternoone. Againe, whereas mention is made in the Gospell of Saint Matthew, of the labourers that came to worke in the Vineyard at the eleventh houre, is to be understood at five of the clocke in the afternoone, or rather one houre before the Sunne set, for you must thinke that the Sunne riseth not, nor yet goeth downe in Iewrie, alwaies at five of the clocke, for then they should have no artificiall day nor night, but all daies and nights should be alike. Also they divided the artificiall night into foure quarters, otherwise called by them the foure watches of the night: for the first three houres was the first watch, during which time all the Souldiers both young and old of any fortified Towne were wont to watch: the second three houres they

called the second watch, which was about the dead of the night, at which time the young Souldiers only watched, and the third quarter of the night containing also three houres, and was called the third watch, the Souldiers of middle age did watch, and the last three houres called the fourth watch, which was about the breake of day, the old Souldiers onely watched. But now because the ancient Astronomers doe appoint the government of the unequall houres to the seven Planets, it shall not be amisse to shew you here what Planet raigneth every houre both day and night.

Chap. LIIII.

How to know what Planet raigneth in every houre of the day or night artificiall, as well by helpe of a Table, as by a rule contained in one verse.

At first I will describe unto you the Table, and then briefly set downe the use thereof. In the first collumne of this Table on the left hand are set downe the seven daies of the weeke, whereof the first is Sunday, and the second Munday, and so forth downward to Saturday: against every which day the Planets are placed towards the right hand, every one in his course one after another, and in the first row of this Table which is the head or front thereof, are placed the houres of the day written in Arithmeticall figures, and in the next row of the said front are set downe the houres of the night written as you see in common numerall letters.

The

The Table.

Houres of the day.	1	2	3	4	5	6	7	8	9	10	11	12	
Houres of the night.	iii	iiii	v	vi	vii	viii	ix	x	xi	xii		i	ii
Sunday.	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂
Munday.	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿
Tuesday	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃
Wednes.	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀
Thursd.	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄
Friday	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉
Saturd.	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽

The use of the Table.

NOw the use of the said Table is thus: whensoever you would know what houre of the day or night any Planet raigneth, you must first seeke out the houre of the day or night, and if it be of the day, then you shall find it in the first row of the front, if of the night, in the second row of the front, as hath been said before: and from that houre descend with your finger to the common Angle standing right against the day which you seeke, and that will shew you what Planet then raigneth. As for example, if you would know on Wednesday at the eighth houre of the day what Planet raigneth, then having found the number of eight in the front, written in Arithmeticall figure, come straight downe from thence with your finger to the common Angle standing right against Wednesday, and you shall find that Mercury raigneth. And if you would know what Planet raigneth the same day at the eighth houre of the night, then descend from the houre of the night downe to the common Angle, and you shall find that the Sunne raigneth, and so forth of all the rest.

The rule contained in one verse, and the use thereof.

The Rule in verse is thus:

Sol, Ve, Mer, Luna, Saturnus, Iupiter, and Mars.

These seven words (the conjunction being left out) doe signifie the seven Planets: For Sol is the Sunne, Vestan, beth for Venus, Mer for Mercurius, Luna is the Moone, and the other three Planets following as Saturnus, Iupiter, and Mars, doe make up the number of seven, which must alwaies follow one another, in such order as they are here set downe in the foresaid verse, and to have the true use of this Rule, you must first apply every Planet to his owne proper day, as Sol to Sunday, Luna to Munday, Mars to Tuesday, Mercurius to Wednesday, Iupiter to Thursday, Venus to Friday, and Saturnus to Saturday, for every one of these Planets goverueth the first houre of his owne proper day, and the Planet placed next to him in the verse, goverueth the second houre of the same day, and so forth orderly, as for example. If you would know what Planet shall raigne on Sunday at the third houre of the day, you must first say that Sol doth raigne the first houre, because that is his day, and Venus raigneth the second houre, and Mercury the third houre, according to your Rule, and so by keeping the order of the verse, you shall easily appoint to every houre both of the day and of the night artificiall his owne gouernour: For though both day and night be divided each of them into twelve houres, making in all foure and twenty houres, and that there be but seven Planets, yet by appointing every Planet to his owne proper day as governour of the first houre of the same day, and by observing the order of the verse in repeating the said Planets, you shall not faile to give to every houre his proper Planet. This sufficeth when the daies and nights are equall, viz. of twelve houres a peece, which is only in March and September, when the Sunne is in the Equinoctiall, but if the day or night consist of more or lesse than twelve houres, then there must be an equality of parts made betwixt the day and the night, for howsoever that the day may be sixteene houres, and the night but eight, and either of them more or lesse, yet must each of them bee divided into twelve equall parts or planetarie houres, for when the day is sixteene houres long, then will the planetarie houre, or the twelfth part of that day be eightie minutes or one naturall houre.

houre and 20', at which time the night being but eight houres, the twelfth part thereof or planetarie houre will be but 40' of a naturall houre: and if you would at any time convert the ordinary houres of the day into planetarie houres, thereby to know the length of a planetarie houre, how long or short soever the day or night is, multiply the houres of the day or night by sixty, and to the product adde the odde minutes, if there be any, that totall divide by twelve, the quotient sheweth the number of minutes that each planetary houre shall containe.

Thus having sufficiently spoken of the Celestiall part, I will now proceed to the Elementall part of the World, contained in the second Booke of this Treatise.

THE SECOND PART OF THE SPHEARE.

CHAP. I.

Of the Elementall part of the World.

WHat doth the Elementall part containe?

I told you before, that as the Celestiall part doth containe the eleven heavens before described, so the Elementall part containeth the foure Elements, that is to say, Fire, Ayre, Water, and Earth, which are of themselves pure substances, and the first and next beginnings whereof all mixt bodies are compounded, and therefore not to be seene with our outward eyes, for as we our selves are bodies compound, so with our outward senses we can discerne nothing but that which is compound: and therefore the fire, aire, water, or earth which we daily feele or see, are not the Elements themselves, but things compounded of them. The natures and properties of which Elements I mind here but briefly to touch, sith the exact handling thereof belongeth rather to naturall Philosophers and to Physitians, than to Geographers, who have to deale only with the situations of the earth, with Zones, Parallels, Climes, Longitudes, Latitudes, Distances, and such like things belonging to the measure and description of this Earth herewhich we inhabit.

Define these Elements?

CHAP.

Chap. II.

Of the Fire, and of his nature and motion.

THe Fire is an Element moſt hot and drie, pure, ſubtill, and ſo cleare as it doth not hinder our ſight, looking thorow the ſame towards the ſtars, and is placed next to the Spheare of the Moone under the which it is turned about like a celeſtiall Spheare.

Chap. III.

Of the Aire, and into how many Regions it is divided.

NExt to Fire is the Aire, which is an Element hot and moiſt, and alſo moſt florible, pure and cleare, notwithſtanding it is farre thicker and groſſer, as ſome ſay, towards the Poles than elſewhere by reaſon that thoſe parts are fartheſt from the Sunne: and this Element is divided of the naturall Philoſophers into three Regions, that is to ſay, the higheſt Region, the middle Region, and the loweſt Region, which higheſt Region being turned about by fire, is thereby made the hotter, wherin all fiery impreſſions are bred, as lightnings fire-drakes, blazing ſtarres and ſuch like.

The middle Region is extreame cold by contrary oppoſition, by reaſon that it is placed in the middeſt betwixt two hot Regions, and therefore in this Region are bred all cold watrie impreſſions, as froſt, ſnow, Ice, haile, and ſuch like.

The loweſt Region is hot by the reflexe of the Sunne, whoſe beames firſt ſtriking the earth, do rebound back againe to that Region, wherein are bred clouds, dewes, and raines, and ſuch like moderate watrie impreſſions; which three Regions of the Aire, with the reſt of the Elements this figure doth plainly ſhew.

Chap.



Chap. IIII.

Of the Water, and whether it be round or not.

NExt to the Aire, is the Water, which is cold, moyst, and flexible, and being lighter than the Earth would of his owne nature surmount and cover the whole earth, had not God in the creation of the World divided waters from waters (as the Booke of Gen. saith) and gathered together those waters that are under the firmament into certaine concavities of the earth, leaving other parts of the earth drie, and discovered, that man and beast might inhabite the same,

ſame, and haue food neceſſary for their behooſe, ſo as now both water and earth doth make one entire and Spherical bodie, which is enuironed with the Aire.

Is not the water a round body of it ſelfe without the earth?

Many late Writers doe deny the whole body to be round, affirming only the Conuex ſuperficies or upper face of the water to be round: for (ſay they) the earth being not altogether round, the Concaue ſuperficies of the water cannot bee round, notwithſtanding the moſt part of the ancient Writers doe affirme the whole body of the water to be round, ſaying that the water hath the like ſhape in his whole, that it hath in his parts: For the parts which are drops are round, ergo the whole is round. Againe, they proue the water of the ſea to bee round, by demonſtration thus: ſuppoſe a ſhip to depart from the ſhore whereon ſome marke is ſet, which you may ſee with a right levelled line ſtanding at the ſterne of the ſaid ſhip, but ſailing further from the ſhore, you cannot ſee the mark any more ſtanding upon the Sterne, but ſhall be faine to go up to the toppe of the Maſt to ſee it, by reaſon that the water being a round bodie riſeth and ſwelleth in the middeſt, and ſo letteth your ſight, as this Figure plainly ſheweth.



Chap. V.

Of the earth, and whether it be all round or not

NExt to the Water is the Element of the Earth, which of his nature is thicke, heavie, cold, drie, and not flexible as is the water and aire, but is firme and apt to kæpe his place. And though some deny the earth to be round, because of the high mountaines, and dæpe dales and valleys therein, which are nothing in comparison of the whole earth to alter that roundnesse which it hath by nature, yet Aristotle affirmeth in his second Booke de cælo & mundo, the fourtæenth Chapter, that the earth of his owne nature is round, proving the same as wel for that the Moone when shæ is eclipsed in part could not have such horned shape as this figure representeth, unlesse the earth were also round, by the interposition whereof shæ is eclipsed, either totally or in part, as hath bæne said before. Againe, he proveth the roundnesse of the earth by the altering of the Horizon, for in going from North to South, our Horizon altereth in such sort as we discover those Starres which wæ could not sæ before, but were cleane hidden from our sight. Some also deny that the earth is in the middest of the world, and some affirme that it is moveable, as also Copernicus, by way of supposition, and not for that he thought so indæd: who affirmeth that the earth turneth about, and that the Sun standeth still in the middest of the heavens, by helpe of which false supposition hæ hath made truer demonstrations of the motions and revolutions of the celestiall Spheares, then ever were made before, as plainly appeareth by his booke de Revolutionibus, dedicated to Paulus Tertius the Pope, in the yære of our Lord, 1536. But



Ptolomie,

Ptolomie, Aristotle, and all other old writers affirme the Earth to be in the middest, and to remaine unmoveable, and to be in the very Centre of the World, proving the same with many most strong reasons not needfull heere to be rehearsed, because I thinke few or none do doubt thereof, and specially the holy Scripture affirming the foundations of the earth to be laid so sure, that it never should move at any time: Againe, you shall find in the selfe-same Psalme these words. He appointed the Moone for certaine seasons, and the Sunne knoweth his going downe, whereby it appeareth that the Sunne moveth and not the earth. But leaving this matter, we will now speake of the compasse of the earth, and of the longitude and latitude thereof.

Chap. VI.

Of the Compasse of the earth, and of the diversity of measures according to divers countries.



Can the whole earth be measured?

Yea very well: for fith the earth and the water (as hath bin said before) doe make together one whole Spheaticall or round body, and that every great Circle as well thereof as of the heavens, containeth 360 degrees, there is no more then to be done, but to allow for every such degree sirtie Italian miles, which differ not much from our English miles, so as in multiplying 360 degrees by sirtie, you shall finde the whole compasse of the earth to be 21600 miles: of which compasse if you would know the true Diameter, then having multiplyed the said compasse or circuit of 21600 miles by seven, divide the product thereof by two and twenty, and the quotient together with the remainder, will shew the true Diameter, which is 6872 miles, five furlongs and $\frac{2}{11}$ of a furlong, and the halfe of that is the semidiameter of the earth which is 3436 miles and $\frac{1}{11}$ of a mile: and as the Italians and we Englishmen do measure great distances on the earth by miles, so the French,

the

the Spaniſh and the high Almaines, doe meaſure ſuch diſtances by leagues both by land and ſea, and every one differeth from other: for the French league containeth two of our miles, the Spaniſh league three, and the common league of Germany foure, and the great league of Germany containeth five of our miles, yea in ſome places of Germany, as in Suevia, the leagues are ſo long as a man ſhall ſcant ride three of them in a whole day. Againe, the Grecians did meaſure the diſtances of the earth by furlongs, the Egyptians by ſignes, and the Perſians by paraſanges, all which meaſures doe greatly differ even in the ſmalleſt part, from whence all meaſures do take their firſt originall: for as well amongſt the ancient men, as amongſt them of later daies, foure barley kernels couched cloſe together ſide by ſide, and not endlong, are ſaid to make a finger breadth, and three finger breadths an inch, and three inches a palme or hand breadth, and three palmes or nine inches a ſpan, and foure palmes or hand breadths a foot, and two foot and a halfe to make a common pace, and five foot to make a Geometricall pace, of which kind of paces, 125 doe make a furlong, and eight furlongs doe make an Italian mile, and foure ſuch miles doe make a common Germaine league, as hath bin ſaid before: But by reaſon that the barley kernels be not in all countries of like bigneſſe, neither finger breadthes, ynches, handbreadthes, feet, nor any of the other meaſures are found any where to be equall: for the French foot of Paris is longer then ours by an ynch, and the Italian foot is longer by two inches and more, and yet their miles are ſomewhat ſhorter then ours, and the Germane foot (according to Stophlerus) is leſſe than ours by two inches and a halfe. But to ſhew the diverſity of meaſures would require a long diſcourſe more intricate than profitable, and therefore I leave to talke any further thereof, wiſhing you when we ſpeake of miles, furlongs, paces, or feet, to conſider the meaſure thereof according to the ynch or foot of our Engliſh Standard.

CHAP.

Chap. VII.

Of the Longitude and Latitude of the earth.

WHat meane you by the longitude and latitude of the earth?

Longitude is as much to say as length, and latitude signifieth breadth, for sith the earth is a body, it must needs have both length, breadth, and depth.

How define you such longitude and latitude, and how it is to be counted?

The longitude of the earth in generall is that space or upper face of the earth which extendeth from West to East, and againe from East to West: and the Latitude in generall is that space which extendeth North and South even from the one Pole to the other. Now to know how such longitude and latitude is to be accounted, you must first understand that the Equinoctiall Circle, girding the earth in the very middest is divided into 360 degrees by reason of certaine Meridians, which passing thorow the Poles of the World do cut each halfe of the Equinoctiall in eightene points, which being doubled do make 36 spaces, every space containing ten degrees: and some do divide the Equinoctiall with 36 Meridians, cutting each halfe thereof into 36 points, which being doubled doe make 72 spaces, every space containing five degrees, which commeth all to one reckoning: for five times 72 doe make 360 as well as ten times 36, of which Meridians, be there never so few or many (for you may if you will make halfe as many Meridians as there be degrees in the Equinoctiall, which amounteth to 180) yet according to Ptolomie, that Meridian is said to be first and furthest West ward, which passeth thorow the Ilands called Insulæ fortunatæ, for the West Indies were not knowne nor discovered in his daies, nor yet long time after, since the discovery whereof, the late Cosmographers of these daies doe make the first Meridian to passe thorow the

Ilands

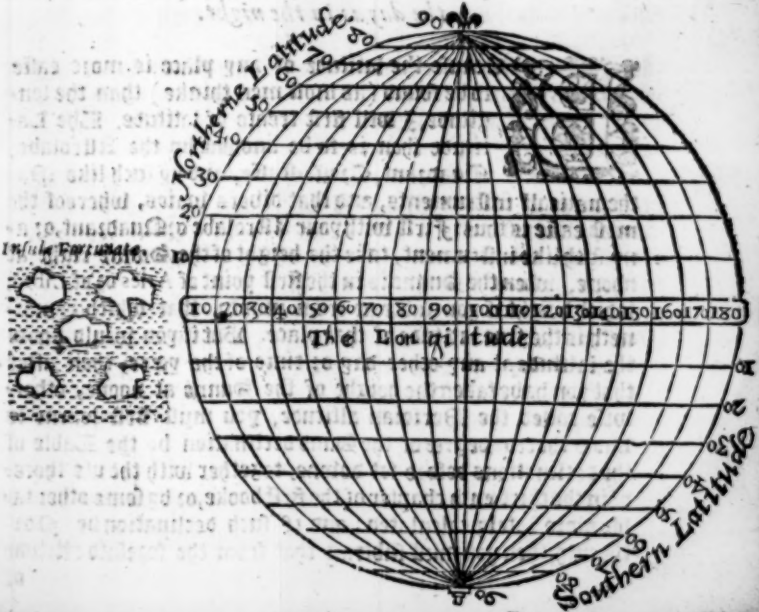
Ilands called Azores, which Ilands as appeareth by their Cards, are situated more Westward from the fore said Insulæ fortunatæ, by five degrees, the reason that moveth them so to doe, is because the Mariners Compasse, as they say, will never incline to the true North Pole, but when they saile either by the Ile Saint Marie, or Saint Michael, affirming that in every other place the Compasse doth vary from the true North, either by Northeasting or Northwesting. And by thus altering the ancient placing of the first Meridian, they must likewise alter all the Longitudes set downe heretofore by Ptolomie, or any other ancient Writer. Notwithstanding the matter is easily holpen, for by adding to every Longitude Eastward five degrees, or by subtracting five degrees from every longitude Westward, you shall not greatly vary from those ancient longitudes that be truly set downe. But to returne againe to my first purpose, I say that whersoever this first Meridian cutteth the Equinoctiall, there beginneth the first degree of longitude, which proceedeth Eastward untill you come to 180 degrees, which being the one halfe of the Earth, is as farre as you can go Eastward, for then, the earth being round, you must needs turne againe Westward, untill you come to the 360 degrees which is the last degree of longitude, and endeth where the first degree beginneth: and therefore the Cosmographers measuring alwaies the longitude by the degrees of the Equinoctiall, doe define longitude to be that portion of the Equinoctiall circle, which is contained betwixt the first Meridian and the Meridian of any place supposed, but the distance betwixt any two supposed Meridians (neither of them being the first Meridian) is not called of them longitude, but the difference of longitude: For suppose the distance of the one Meridian, to be twenty degrees distant from the first Meridian, and the other but ten, these longitudes you see are not alike, but doe differ and therefore the distance betwixt any two such places may be very well called the difference of longitude, and not longitude it selfe, which hath alwaies regard to the first Meridian and to none other.

Define once againe what latitude is?

Latitude is none other thing but the distance of any place from

from the Equinoctiall either towardes ỹ North Pole or towardes the South Pole, so as there be 2 kinds of latitudes, the one northern and the other southern: & such latitude is measured upon the Meridian, which passeth thorow many places supposed. For every meridian is also divided into 360 degrees, & by reason that the Equinoctial girdeth all such Meridians in the very midst, it divideth them al into foure equall quarters, every quarter containing 90 degrees, which is the greatest latitude that any place can have, as you may see in this figure following, whereof the first Meridian on ỹ left hand is put to signifie, according to Ptolomie, that which passeth thorow the fortunate Ilands, or by the Azores according to the moderne Cosmographers (if you will have it so) containing the degrees of the latitude both Northward and Southward: and thorow the midst of all the Meridians passeth the Equinoctiall containing the degrees of the longitude.

The figure of the longitude and latitude of the World.



What be the other manifold circles in this figure dividing the Meridians on each side of the Equinoctiall, as well towards the North Pole, as towards the South Pole?

They are called Parallels, whereof we shall speake in the seventeenth Chapter: in the meane time marke well this figure, that thereby you may the better conceive what is the longitude and latitude of the earth.

Understanding now the longitude and latitude of the whole earth, I am desirous to know how the longitude and latitude of every severall place of the earth or sea is to be found out, and how farre one place is distant one from another.

Chap. VIII.

How to know the latitude of any place, as well in the day as in the night.

Because the latitude of any place is more easie to be found (as most men thinke) than the longitude, I will first treate of latitude. The Latitude then is to be knowne by the Astrolabe, Quadrant, Crosse-staffe, and by such like Mathematicall instruments, and that divers waies, whereof the most easie is thus: First with your Astrolabe or Quadrant, or any such like instrument, take the height of the Sunne right at noone, when the Sunne is in the first point of Aries or of Libra, which height if you subtract from ninety, that which remaineth is the true latitude of that place. But if you would know the latitude at any other day or time of the yere, then after that you have taken the height of the Sunne at noone, otherwise called the Meridian altitude, you must first learne to know the true degree of the Suns declination by the Table of the declinations before set downe, together with the use thereof in the thirteenth chapter of the first booke, or by some other table more lately calculated: and if such declination be Northerly, then you must subtract that from the foresaid altitude

or

or height: but if the declination be Southernly, then you must adde the same unto the foresaid height, and by such subtraction or addition, you shall have the height of the Equinoctiall above your Horizon, which being subtracted from ninety, that which remaineth is the true latitude of that place: and to be sure in taking the Meridian altitude, it shall be needfull to take it diuers times one after another, with some little pawse betwixt, to see whether it encreaseth or decreaseth, for if it doth encrease then it is not yet full noone, but if it decreaseth, then it is past noone. This last way of finding out the latitude is, and hath bin most commonly taught, as well by the ancient, as moderne writers, as a most sure and ready way of finding the latitude of any place.

What if the Sun do not shine at noone, nor perhaps al that day?

Then you must tarry untill night that some starre appeare, which you perfectly know, and such a one as both riseth and setteth. And having taken the Meridian altitude of that starre with your Astrolabe or Quadrant, you must learne what declination he hath, and whether it be Northerne or Southerne. For if the starre hath North declination, then you must subtract his declination from his Meridian altitude, and the remainder shall be the altitude of the Equinoctiall, which being taken out of ninety, shall be the Latitude of the place, or elevation of the Pole: but if the declination of the starre be Southernly, then you must adde his declination to his Meridian altitude, and that summe shall be the altitude of the Equinoctiall, which being taken out of ninety, the remainder shal be the elevation of the Pole: As for example, supposing that you know the starre called Arcturus or Bubulcus, and that you find his Meridian altitude by your Astrolabe or Quadrant to be fifty nine degrees thirty minutes, and also that you have learned by some Table, that his declination to the Northward is one and twenty degrees thirty minutes, here by taking his said declination, because it is Northernly, out of his Meridian altitude, you finde the remainder to be thirty eight degrees, which is the altitude of the Equinoctiall, which being taken from 90, the remainder will be 52 degrees, which is the Lati-

tude of that place whereas you made your obſervation, and this is a farre more ready way, then to waite all night to take the Meridian altitude, and alſo the depreſſion of ſuch a Starre as never ſetteth. which is ſeldome done in one ſelfe-night. And therefore I would wiſh all Mariners to acquaint themſelves with many Starres that doe both riſe and ſet, and ſo ſhall they be ſure to find one ſuch Starre or other, to be at his Meridian altitude at any houre of the night that they deſire, if the ſtars do ſhew.

Chap. IX.

How to know the Longitude of any place.

Though the longitude may be found out by diuers wayes not eaſie for every mans capacitie, yet becauſe Gemma Friſius thinketh none ſo ſure as to know the ſame by the Eclipſe of the Moone, which alſo (as he ſaith) may ſometime faile by reaſon of the diuerſity of aſpects and latitude of the Moone, and for that cauſe hath inuented a more ready way to find out at all times the longitude of any place, I mind here therefore briefly to ſhew you firſt the order of finding out the longitude by the Eclipſe of the Moone, and then how to find out the ſame by that ready way which he hath inuented: the order then to know it by the Eclipſe of the Moone is thus: Firſt you muſt learne by ſome Ephemerides, at what houre the Eclipſe ſhall bee in ſome place, where you know already by ſome Table the Longitude: that done, you your ſelfe, or ſome other for you, muſt the ſame day of the Eclipſe obſerue by the Aſtrolabe at what houre the Eclipſe beginneth in that place, whereof you know not the Longitude: For if the Eclipſe do beginne in both places at one ſelfe-houre, then aſſure your ſelfe that both places haue one ſelfe Longitude, but if it beginne ſooner or later, then there is difference betwixt them according to the variety of the time, which difference

rence is thus to be knowne: take the lesser summe of houres out of the greater, and there will remaine either houres, or minutes, or both; if houres, then multiply the same by fifténe, if minutes, divide the same by foure, (for in this account fifténe degrées do make one houre, and foure minutes do make one degrée) and adde the difference to round to the longitude, if the Eclipse doe appeare there sooner; if later, then subtract the said difference from the knowne longitude, and that which remaineth will show the unknowne longitude. But note by the way, that if there remaine any minutes after the sixth in, you must multiply those minutes by fifténe, and so shall you have the minutes of degrées.

Shew the use of this Rule by some example.

For example, I find by the Rule of Ptolomie, that the longitude of Paris in France is three and twenty degrées, and by some Almanacke or Ephemerides I find that the Eclipse doth beginne there at three houres after midnight: now by this I would know the longitude of Tubing, a famous citie in Suevia, which is a region of Germany, at which Towne in the very day of the Eclipse I cause to be observed by my Astrolabe, at what houre the Eclipse beginneth there, and I find that it beginneth at three of the clocke and 24′ after midnight: then by subtracting the lesser number of time out of the greater, I find the remainder to be 24, which being divided by 4′, which doe make one degrée, the quotient shall be six degrées, and that is the difference, which being added to the knowne longitude of Paris (because the Eclipse is sooner there than at Tubing) it maketh in all nine degrées, whereby I gather that the longitude of Tubing is nine and twenty degrées. By this meanes all the Tables of Cosmographers are most commonly made, and yet many times they greatly differ in their longitude for lack perhaps of using diligence in taking the right houre and moment of the Eclipse, and for not duly considering the divers aspects, and what latitude the Moone hath at that instant, which may cause great error.

Chap. X.

A ready way to find out the Longitude of any place, invented by Gemma Frisius.

That way is done by the helpe of some true Horologie or watch apt to be carried in journeying, which by an Astrolable is to be rectified and set just at such houre as you depart from the place where you are, to go to any other place whereof you are desirous to know the Longitude: in which your going you must be diligent to see that your watch never cease going, and being arrived at that place whereof you seeke to know the Longitude, you must tarry untill the Sunne do justly touch the pitch of some perfect houre, and also at that instant, to see what houre it is by your Astrolabe: for if your Astrolabe and watch do both agree in one, then assure your selfe that there is no difference of Longitude, but that you have travelled still under one selfe Meridian either towards the North or South. But if they differ one houre or certaine minutes, then reduce them to degrees, or to the minutes of degrees in such order as is before taught, and thereby you shall find the Longitude which you desire to know. But to take the Longitude of any place upon the Sea by this manner of way, most men thinke it were a great deale better to do it by the helpe of a great houre-glasse, made to runne foure and twenty houres, which must be watched when it is ready to runne out, that it may be immediatly turned: for watches made of Iron or Steele will soone rust upon the Sea.

Chap.

Chap. XI.

Another way taught by Appian *to find out the Longitude of any place with the Crosse staffe, by knowing the distance betwixt the Moone and some knowne Starre that is situated nigh vnto the Ecliptique.*

FIrst seeke to know by the Astronomicall Tables the true moving of the Moone according to the Longitude at that time of your observation at some certaine place, for whose Meridian the Rents of those Tables are calculated and verified. Also you must know the degree of Longitude of some fixed starre nigh vnto the Ecliptique going either next before or else next after the moving of the Moone, then you must seeke out the distance of the moving of the Moone and of the said starre, which distance once had, apply the Crosse-staffe to your eye, and moue the crosse vp and downe vntill you may see the center of the bodie of the Moone with the one end of the crosse, and the foresaid fixed starre with the other end of the crosse: so shall the crosse shew you by the degrees and minutes marked vpon the staffe, the distance of the Moone and of the foresaid starre, answerable to the place of your obseruation; which being set downe, set downe also the distance betwixt the Moone and the foresaid starre that was first calculated, and then take the lesser out of the greater, so shall remaine the last difference, which may be rightly called the diuersitie of aspects: which difference if you diuide by the moning which the Moone maketh in one houre, you shall know thereby the time in which the Moone is or was ioyned with the first distance of the foresaid starre, then hauing conuerted that time into degrees and minutes, adde or subtract the product thereof to or from that Meridian, vnto which the Tables (whereby you first calculated the moning of the Moone) were verified, that is to say, if the distance betwixt the Moone and the fixed starre of your obseruation be lesser, then adde the degrees and minutes to the

knowne longitude, so shall you find the place of your observation to be more Eastward, but if it be greater, then subtract the degrees and minutes from the knowne longitude, and the place of your observation shall be more Westward. All which Rules Gemma Frisius affirmeth to be true, so as the Moone be more Westward than the fixed Starre: for if at the time of your observation the Moone be more Eastward, then you must worke cleane contrary: that is to say: if the distance betwixt the Moone and the fixed Starre be lesser, you must subtract the degrees and minutes from the knowne longitude, so shall the place of your observation be more Westward: but if it be greater, then you must adde the degrees and minutes unto the knowne longitude, and you shall find the place of your observation to be more Eastward.

CHAP. XII.

How to know the distance of places, that is to say, how many miles one place is distant from another, and how many wayes places are said to differ in distance one from another.

THe distance may be knowne divers wayes, that is, either Arithmetically, Geometrically, or by the Tables of Sinus. But before I shew you the order of any of these wayes, you have to understand that any two places do differ in distance one from another one of these three manner of wayes that is, either in latitude only, or in longitude only, or else in both. If two places having one selfe longitude do differ only in latitude, then according to the Arithmeticall way you must subtract the lesser latitude out of the greater, and the remainder shall be the difference, which being multiplied by fiftie, will shew the number of miles: as for example, London and Roan having in a manner one selfe longitude, doe differ only in latitude, for the latitude of London is one and fiftie degrees, 32.

and

and the latitude of Roan is forty nine degrées and 10′, which being the lesser latitude, and therefore to be taken out of one and fiftie degrées 32′, there remaineth two degrées 22′, which two degrées being multiplied by sixtie, maketh 120, whereunto if for the 22′ annexed to the degrées you adde two and twentie miles (for every minute is a mile) it shall make in all 142 miles, which by a right line is the true distance betwixt London and Roan. But you have to note that the difference of two sundry latitudes is not to be knowne by subtracting the lesser out of the greater, unlesse both the places bee so situated, as both have either North latitude or South latitude: for if the one place have North latitude, and the other South latitude, the difference is to be knowne by addition, and not by subtraction. As for example, Naples in Italy hath one and forty degrées of North latitude, and la Madelena in Affrique, not farre from Manicongo, hath eight degrées of South latitude, both places having one selfe Meridian. Here the difference of these two latitudes is to be knowne by addition, and not by subtracting the lesser out of the greater, for eight and one and forty being added together doe make nine and forty, and that is the true difference, which being multiplied by sixtie, maketh 2940 miles. So likewise the difference of the two longitudes is not alwaies knowne by subtracting the lesser out of the greater, unlesse the two places have both East longitude, or else both West longitude. As for example, Lisbona in Spaine hath in East longitude thirteene degrées, and Cap de los Slavos in the West Indies hath in West longitude 334 degrées: here the difference of these two longitudes is not to be knowne by taking the lesser out of the greater, but thus: first take 334 out of 360, and there will remaine six and twenty degrées, whereunto if you adde the East longitude for Lisbona, which is thirteene degrees, it will make in all nine and thirty degrees, which is the true difference of the two longitudes, for if you shall take thirteene degrees out of 334, there would remaine 321, which is not the true difference. But to know the distance of two places differing in longitude, this Table here following is needfull.

The Table of miles answerable to one degree of every severall Latitude.

1			2			3			4			5			6		
D	M	S	D	M	S	D	M	S	D	M	S	D	M	S	D	M	S
1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	55	18	57	4	33	50	19	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	42	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

Describe this Table.

This Table is divided into six collumns, every collumn containing, first the degrees of latitude, and then the myles and seconds of miles, answerable to every degree: for every degree of the very Equinoctiall it selfe is in value sixtie miles, but the further you goe from the Equinoctiall either Northward or Southward, every degree of Latitude is lesser in value than other, and containeth fewer miles, as you may easily see by the said Table, proceeding from one degree to ninetie, which is the greatest Latitude that any place can haue.

CHAP.

Chap. XIII

How to know by the helpe of the foresaid Table the distance of two places differing only in Longitude.



You must multiply the Difference of the Longitudes by the number of miles answerable to the Latitudes of the said places, omitting alwayes the Seconds of miles set downe in the said Table, because in this account they are of small importance: as for example, London and Antwerp, having both in a manner one selfe Latitude, do differ only in Longitude six degrees, 42′, which difference being multiplyed by 37 miles answerable to 51 degrees of Latitude, as you see in the Table, do make in all 247 miles, and 54″ of a mile. But in making this multiplication, you must first multiply the six whole degrees by 37, and the Product thereof will amount to 222, then by the Rule of proportion you may find out the value of the minutes annexed to the degrees of the difference of Longitude in saying thus, if 60′, which is one degree, do require 37 miles, what shall 42′ require? And by working according to the Rule of proportion, you shall find the fourth number which you seeke to be 25 miles, and 54″, which being added to the first Product 222, maketh in all 247 miles, and 54″ of a mile, which wanteth but 6′ to make up another mile.

Chap. XIV

How to find out the true distance of two places differing both in Longitude and Latitude by the Arithmeticall way.



How is that done?

First, take the difference of the Longitudes and Latitudes of both places by subtracting the lesser out of the greater, then convert the same into miles by multiplying the difference of the two Longitudes into the miles, that

that be answerable to the latitude of each place, which miles you shall find in the Table aforesaid, and if there be any minutes annexed to the degrées of the difference of Longitude, then reduce the same also to miles by the Rule of proportion, as before is taught, and having added the two products together, take halfe the summe, and set it by it selfe. Then multiply the difference of the latitudes into fiftie miles, and adde thereunto the Fraction of minutes annexed to the said difference if it hath any fraction, allowing for every minute one mile, and set that number also by it selfe: that done, square the summes reserved, that is to say, multiply each one a part by it selfe into it selfe, and having added the two products together into one sum, seeke out the square Root thereof, and that shall be the true distance of the two places. As for example, if you would know the true distance betwixt London and Venice, first you must know by some Table the longitude and latitude of both Townes, wherefore finding the longitude of London to be nineteene degrées 54', and the latitude thereof to be 51 degrées, 32'. And the longitude of Venice to be 35 degrées 30', and the latitude thereof to be 44 degrées 45'. Now by subtracting the lesse longitude out of the greater, I find the difference of longitude to be fifteene degrées, 36', and by subtracting the lesser latitude out of the greater, I find the difference of latitude to be sixe degrées 47'. Then knowing the latitude of London to be 51 degrées, I resort to the Table of miles appointed for every degree of latitude before set downe, and there I find that to 51 degrées of latitude doe answere 37 miles, and certaine seconds, which being of small moment are not wont to be reckoned. Then in multiplying the difference of the longitudes which is fifteene degrees 36', by 37 miles, I find the product of the fifteene degrees to multiplied, to be 555, and because there be 36, annexed to the foresaid fifteene degrees, I seeke by the Rule of proportion to know how many miles that fraction containeth. in saying thus; if fortie require 37, what shall 36 require? and I find two and twenty miles: which being added to 555. maketh 577, then by seeking in the foresaid Table how many miles be answerable to the latitude of Venice, which is 44 degrées, I

find

find the number of miles to be 43, by which number I multiply once againe the difference of longitude, which is fifteene degrees 36′, the product whereof, together with the fraction annexed therennto, being converted in to miles by the Rule of proportion as before, doth amount to 670, which summe being added to the former converted longitude, which is 577, maketh in all 1247, the halfe whereof is 623 ½ which halfe number I reserve by it selfe: that done, I multiply the difference of the latitude, which is fix degrees 47′ by fixtie mile, in saying, fixe times fixtie maketh 360, whereunto I adde for the 47′ annexed 47 miles, and it maketh in all 407, which summe I reserve also by it selfe. Then I multiply the first reserved number into it selfe, the product whereof is 388129: that done, I multiply the second reserved number also into it selfe, the product whereof is 165649, which two last products being added together do make in all 553778, whereof the square Root being taken, is 744 miles, which is the true distance of Venice by a right line from London. And to the intent that the order and working herein may more plainely appeare unto you, I have set downe all the particular numbers of the same heere by themselves, as it were in a Table.

	Longitude.	Latitude.
London.	19 degrees, 54′.	51 deg. 32′.
Venice.	35 degrees, 30′	44 deg. 45′
The difference of their longitudes and latitudes.	15 degrees, 36′.	6 degr. 47′
The difference of the Longitudes converted into miles: for London is		577
For Venice		670
The summe of the two converted longitudes added together, is		1247
The halfe whereof, which is the first reserved number, is		623

The

The ſecond reſerved number, which is the difference of the latitudes, converted into miles, is	407
The ſumme of the firſt reſerved number multiplied into it ſelfe, is	388129
The ſummeof the ſecond reſerved number multiplied into it ſelfe, is	165649
The ſumme of both added together, is	553778
The ſquare root wherof, which is the ſumme of the miles, is	744

Chap. XIIII.

How to find out the diſtance betwixt two places, differing both in longitude and latitude, by helpe of a Semicircle divided into 180 degrees, without any Arithmeticke.

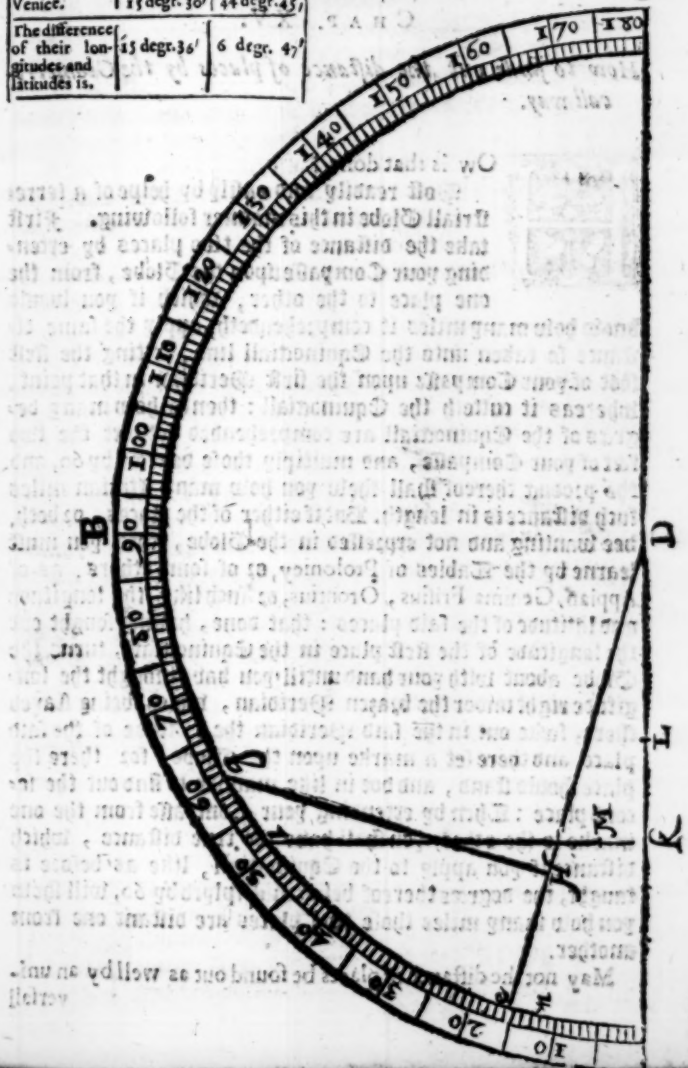
But now becauſe the way before taught to finde out ſuch diſtance by the Arithmeticall way may ſeeme perhaps to ſome folkes very buſie and tedious, I have thought good therefore to ſet down this other way which was ſent mée not long ſince from my loving friend Maſter Wright of Caius Colledge in Cambridge, who is well learned in the Mathematiques, and is ſo apt thereunto by nature, as hée is like enough to attaine to ſuch perfect knowledge therein, as he may be able thereby hereafter greatly to profit his countrey, if for want of ſufficient exhibition he be not forced to leave ſo noble a ſtudie. Wherefore I wiſh with all my heart that all Gentlemen of ability were minded to ſhew their liberality towards him in that behalfe. But to returne to my matter, I ſay that the way to find out the foreſaid diſtance is this héere following: firſt having drawn a Semicircle upon a right Diameter (the larger that the Semicircle is, the better) and divided the ſame into 180 degrées, like unto this hereafter deſcribed, and marked with the letters A, B, C, D, whereof D is the centre, and A, C, the Diameter; then

Then learne first by some Table to know the Longitude and Latitude of both places, and the difference of their Longitudes, as you did before in seeking to know by the Arithmeticall way the distance betwixt London & Venice, the difference of whose two longitudes is fifteene degrees, and 36′, as you may see in the former Table: for in working by this way, you have chiefly to seeke out in the circumference of the Semicircle but three things, that is, first the difference of the two longitudes, secondly the lesser latitude, and last of all the greatest latitude. Knowing therefore the difference of the said two places in Longitude to be fifteene degrees, 36′, seeke out the same in the Semicircle, beginning to count at A, and so proceed towards B, and at the end of those degrees and minutes set downe a pricke marked with the letter c, unto which pricke draw a right line by your ruler from D, the center of the Semicircle: That done, seeke out the lesser Latitude which is foure and forty degrees and 45′ in the foresaid Semicircle, beginning to account the same from the pricke c, and so proceed towards the letter B, and at the end of the said lesser latitude, set downe another pricke marked with the letter g, from which pricke or point draw a perpendicular line, which by helpe of your squire or compasses may fall with right Angles upon the former right line drawne from D, to c, and where it falleth, there set downe a pricke marked with the letter h, that done, seeke out the greater latitude, which is one and fifty degrees, and 32′ in the foresaid Semicircle, beginning to account the same from A, towards B, and at the end of that Latitude set downe another pricke marked with the letter l, from whence draw another perpendicular line, that may fall by helpe of your squire or compasse with right Angles vpon the Diameter A, C, and there make a pricke marked with the letter K, that done, take with your compasse the distance that is betwixt K and h, which distance you must set downe upon your said Diameter A, C, setting the one foot of your compasse upon K, and the other towards the centre D, and there make a pricke marked with the Letter L, then take with your Compasse the length of the shorter perpendicular line g, h, and apply that

wideneſſe upon the longer perpendicular line I, K, ſetting the one foot of your Compaſſe at I, which is the end of the greater Latitude, and extend the other foot towards K, and there make a pricke marked with the letter M. That done, take the diſtance betwixt L and M with your Compaſſe, and apply the ſame to the Semicircle, ſetting, the one foot of your Compaſſe in A, and the other towards B, and there make a pricke marked with the letter N, and the number of degrees contained betwixt A and N, will ſhew the true diſtance of the two places, which you ſhall find to be twelve degrees and almoſt 24. Now by allowing for every degree ſixty miles, and for every minute a mile, the ſumme of miles willagree with the former diſtance found out by the Arithmeticall way, which was 744 miles. And thus you have to deale to know the diſtance of any other two places whatſoever, differing both in longitude and latitude. But you have to note by the way, that if the difference of the Longitudes do exceed the number of 180, then you muſt ſubtract that exceeding difference out of 360, and the remainder ſhall be the difference of the Longitudes, and then worke in all points as is before taught. And this way is as Geometricall as that which Appian ſetteth downe in his booke of Geographie, to be done by help of the terreſtriall Globe, the order whereof here followeth.

CHAP.

	Longitude	Latitude
London	19 deg. 54′	51 degr. 32′
Venice.	15 degr. 30′	44 degr. 45′
The difference of their longitudes and latitudes is.	15 degr. 36′	6 degr. 47′



Chap. XV.

How to finde out the distance of places by the Geometricall way.

How is that done?

Most readily and easily by helpe of a terrestriall Globe in this maner following. First take the distance of the two places by extending your Compasse upon the Globe, from the one place to the other, which if you would know how many miles it comprehendeth, apply the same distance so taken unto the Equinoctiall line, setting the first foot of your Compasse upon the first Meridian in that point, whereas it cutteth the Equinoctiall: then se how many degrees of the Equinoctiall are comprehended betwixt the two fæt of your Compasse, and multiply those degrees by 60, and the product thereof shall shew you how many Italian miles such distance is in length. But if either of the places, or both, bee wanting and not expressed in the Globe, then you must learne by the Tables of Ptolomey, or of some others, as of Appian, Gemma Frisius, Orontius, or such like, the longitude and latitude of the said places: that done, having sought out the longitude of the first place in the Equinoctiall, turne the Globe about with your hand untill you have brought the longitude right under the brazen Meridian, which being stayed there, sæke out in the said Meridian the latitude of the said place, and there set a marke upon the Globe, for there the place should stand, and doe in like manner to find out the second place: Then by extending your Compasse from the one marke to the other, you shall have the true distance, which distance if you apply to the Equinoctiall, like as before is taught, the degrees thereof being multiplyed by 60, will shew you how many miles those two places are distant one from another.

May not the distance of places be found out as well by an universall

verſall Map as by the Globe terreſtriall?

Yes indeed, and more readily, by reaſon that for the moſt part every Map hath his proper ſcale, ſo as you need to do no more but to take the diſtance of the 2 places with your Compaſſe, and to apply the ſame to the ſcale ſhewing the miles or leagues.

What if the Map have no ſcale?

Then you muſt ſeeke out the diſtance by ſuch meanes as I do ſhew in my Treatiſe of the uſe of univerſall Mappes, and alſo in my deſcription of Plancius his Map.

I pray you in the meane time proceed in ſhewing me the third way of finding out of the diſtance of places, which you ſaid was *per tabulas Sinuum.*

The order of finding out the diſtance of two places differing both in Longitude and Latitude per tabulas Sinnum, is plainly ſet down before in the end of my Arithmetick, whereas I do make a plaine deſcription of the ſaid Tables, and do ſhew the uſe thereof as well by this as by divers other examples, wherefore I wiſh you to reſort to that Treatiſe, and you ſhall have your deſire. For having for this time ſufficiently ſpoken of the longitude, latitude, and diſtance of places, and how the ſame is to be found out, I think it meet to treat of the 5 Zones, of Climes and Paralels, whereinto the Ancient Coſmographers thought good to divide the Earth, to the intent that every part therof might the better be known how it is ſituated either Northward or Southward, whether it be hot or cold, or betwixt both, and of what length the day and night is in every place, and what manner of ſhadow the Sun yeeldeth every where, and ſuch like accidents: and firſt of the 5 Zones.

CHAP. XVI.

Of the 5 Zones.

THe moſt ancient Coſmographers conſidering how the Sunne by his oblique, and variable courſe, did warme with his beames one part of the earth more than another, gathered thereby that the earth had three temperatures, that is to ſay, extreame hot,

extreame cold, and a meane temperature, that is, neither too hot, nor too cold: And therefore to shew us unto which of these temperatures, any part of the earth was subject, they divided the earth into 5 Zones, answerable to the 5 Zones of the Firmament, by helpe of the Equinoctiall and the 4 lesser Circles before described in the first part of this treatise, the 20 Chapter, and are there set forth in figure, which figure I thought good to set downe againe in this place, to the intent you might the better remember what was said there touching the Zones.



But other Cosmographers comming afterward, not satisfied with the 5 Zones, because they shew nothing but the situation and the three temperatures of the earth, did divide the earth into certaine Climes and Paralels, to find out thereby the length of the day and night in every place, and the true latitude thereof, as Ptolomey and many others after him have done

done, making such divisions as we shall speake of hereafter. But truly I thinke with Mercator, that the best and most exact way of dividing the earth to serve all purposes is to bee made by degrées and minutes, wherein is lesse error than in Climes and Parallels, neither can Climes or Parallels be so well described when you draw nigh to any of the Poles, for that the spaces as well betwixt the Parallels as betwixt the Meridians do grow continually straighter and straighter, as you may see in the figure of Parallels hereafter following.

I remember that in the twintieth chapter whereas you described the five Zones, you said that the ancient men did greatly erre in affirming three of the Zones to be unhabitable, that is, the two cold Zones, and the hot Zone, I pray you therefore shew mee heere the cause why they erred?

They erred for lacke of experience, because they had never travelled into those Regions: but in these later dayes men of divers Nations, especially the Spanish, English, French, and Flemmish, have travelled very farre, some towards the North Pole, and some towards the South Pole, and also thorow the burnt Zone; for those that saile from the North parts towards the South Pole, or from the South parts towards the North Pole, must néeds passe in their voyage thorow the burnt Zone: and these men do affirme that they have found all the three Zones, that is to say, the two cold, and hot Zone to be well inhabited. And our late Cosmographers do not let to render cause why they should be habitable: for (say they) though the cold be very extreame in those regions that lie next unto the Poles, yet the Sun appearing and giving shine unto them both day and night, doth greatly qualifie and moderate the extreame cold of those Regions. But truly, in mine opinion, they have small comfort of the Sun, sith it striketh almost round about their fæt without yelding any warme reflex from above, & especially to those that do inhabit nigh to either of the Poles. Againe, they say that the burnt Zone is habitable, by reason that the night to them is continually as long as the day, the coolenesse whereof doth greatly refresh the extreame heat of the day. But now let us returne to our purpose, and speake somewhat of the

Climes and Parallels, and because every Clime consisteth of two Parallels, I thinke it best to speake first of Parallels.

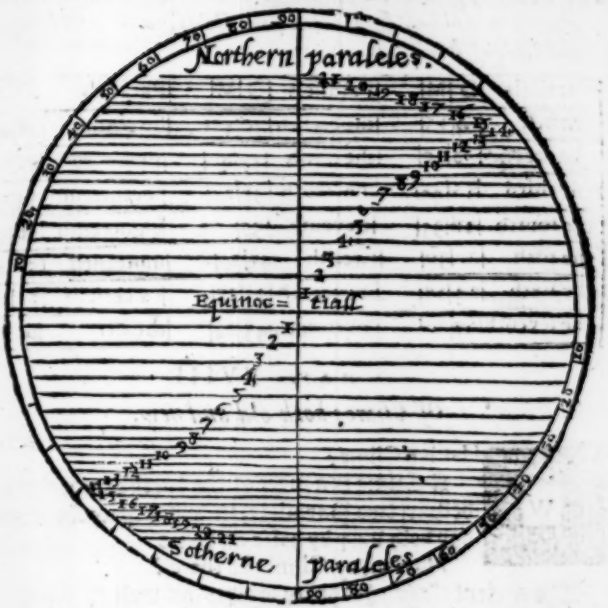
Chap. XVII.

Of Parallels.

WHat be Parallels?

Parallels bee Lines either right or circular, alwayes equally distant one from another, so as they can never meet. And of Parallels that are to be considered in the Spheare, some make three kinds, according to their threefold signification: for some are called the Parallels of the Sunne, who in departing from the Equinoctiall towards any of the Poles, maketh every day throughout the yeere one Parallel, so as in going from the Equinoctiall to the Tropique of Cancer, he maketh 182 Parallels: and as many againe in going from the Equinoctial to the Tropique of Capricorne. The second kind of Parallels are called the Parallels of latitude. And the third the Parallels of the longest day; which two last are in effect both one. For the further that any Parallel is situated from the Equinoctiall towards either of the Poles, the more latitude it hath, and so by consequent maketh the day longer to those that dwell under that Parallel: of which Parallels the ancient Cosmographers do make in all but one and twenty, proceeding proportionally either towards the North Pole or South Pole, as you may see by this figure here following; the middle Line or Circle whereof is the Equinoctiall.

And



And every Parallel proceeding from the said Equinoctiall, either Northward or Southward, doth lengthen the day by one quarter of an houre, in such proportion as this Table here following sheweth, appointing to the first Parallel, and next unto the Equinoctiall foure degrees and 15′, and to the second Parallel eight degrees 30′, and so forth untill you come to the one and twentieth Parallel passing thorow Iland, which Parallel is distant from the Equinoctiall sixty three degrees 16′, further than which Parallel Northward, the Tables of Ptolomie do not extend, and Southward they extend no further than to that Parallel which hath lesse than twentie degrees of latitude.

The Table of Parallels shewing how many degrees and minutes every one is distaunt from the Equinoctiall, made according to the Rule of Ptolomie.

Parallels	D	M	Parallels	D	M	Parallels	D	M
the first	4	15	the eighth	30	45	fifteenth	48	40
the second	8	30	the ninth	33	40	sixteenth	51	50
the third	12	45	the tenth	36	24	seventeenth	54	30
the fourth	16	35	eleventh	39	0	eighteenth	56	30
the fifth	20	30	twelfth	41	20	ninteenth	58	20
the sixth	24	15	thirteenth	43	15	twentieth	61	10
the seventh	27	20	fourteenth	45	24	the xxi	63	16

CHAP. XVIII.

Of Climes both old and new.

WHat is a Clime?

A Clime is a space of the earth comprehended betwixt two Parallels, in which space the longest day doth vary by halfe an houre.

How many Climes be there?

The ancient Cosmographers divided as well that part of the earth which lieth betwixt the Equinoctiall and the North Pole, so much I say as they thought to be habitable, as also the habitable part which lieth betwixt the Equinoctiall and the South Pole, each of them into seven Climes, to every of which Northerne Climes they gave a severall proper name, according to the name of the place thorow which the middest of the said Clime did passe, for they called the first Clime Dia Meroes, Dia is a Greek preposition signifying in English, By or Thorow, and Meroes is a City of Egypt situated in a certaine Ile enclosed with the flood Nilus, which Ile hath also the like name. The second Clime is called Dia Sienes, which is also a City in Egypt situated right under the Tropique of Cancer. The third Clime is called Dia Alexandrias, which is another City of Egypt situated upon the West mouth of Nilus, falling into

into the ſea of Egypt. The fourth Clime is called Dia Rhodon: Rhodos is the chiefeſt City of an Ile called Rhodos, ſtanding in the ſea called Mare Carpathium, waſhing the South-weſt end of Natolia, ſometime called Aſia minor, which Iland together with the City Rhodos, Soliman the great Turke wanne not many yéares ſince from the Chriſtians. The People of this Ile in Saint Pauls time were called Coloſſians, to whom hée wrote one Epiſtle, and they were ſo called of a great brazen Image called in Latine Coloſſus, containing in altitude 105 fet, which was dedicated to the Sunne, or as ſome ſay, to Iupiter. The fifth Clime is called Dia Rhomes, that is to ſay, by Rome that famous City in Italy, and ſometime head of all the world. The ſixth is called of the old men Dia Boriſthenes, notwithſtanding the moderne writers thinke that it may be more rightly called Dia Ponton: Pontus is both a ſea and Country lying Eaſtward right againſt Conſtantinople. The ſeventh Clime is called of the old men Dia Rhipheos, but of the moderne writers Dia Boriſthenes, which is a great flood of Scythia in the South part of Sarmatia which falleth into the ſea called Mare Euxinum. To theſe ſeven Climes, Appian addeth two others, ſo as in all he ſetteth downe nine Climes, making the eight Clime to paſſe thorow Ripheos, which are mountaines environing Sarmatia on the North ſide; and the ninth thorow Denmarke.

What names did they give to the Southerne Climes?

The ſelfe-ſame that the Northerne Climes have, ſaving that they put before every ſuch name this Greéke word Anti, which is as much to ſay, as contrary or right againſt, as Anti-Meroes, Anti-Syenes, &c. as you may eaſily perceive by this figure of Climes here following, notwithſtanding none of thoſe Southerne Climes were knowne to Ptolomy more than Anti-Meroes, and hardly all that, the furtheſt part whereof hath not twenty degréés of latitude.

And



And note, that every such Clime is divided into three parts, that is, the beginning, the midst, and the end. And if you would know what degrees and minutes of latitude every such part hath, that is to say, how many degrees every such part is distant from the Equinoctiall, then consider well this Table following, which both briefly and plainly sheweth the same.

	The beginning.		The midst.		The end.	
Degrees and minuts of latitude.	D	M	D	M	D	M
The first Clime.	12	45	16	35	20	30
The second Clime.	20	30	24	15	27	30
The third Clime.	27	30	30	45	33	4[illegible]
The fourth Clime.	33	40	36	24	39	0
The fifth Clime.	39	0	41	20	43	30
The sixth Clime.	43	30	45	24	47	15
The seventh Clime.	47	15	48	40	50	30
The eighth Clime.	50	30	51	50	53	10
The ninth Clime.	53	10	[illegible]	[illegible]	[illegible]	[illegible]

May not the North and South part of the world each of them be divided into more than nine Climes?

Yes indeed as our later writers affirme: for betwixt the Equinoctiall and the 66 degrees and 30' of latitude, in which the longest day containeth full foure and twentie houres without having any night, they make 48 Parallels, and thereby foure and twenty Climes, for every Clime containeth two Parallels, and every Parallel maketh the day to encrease by one quarter of an houre, as hath beene said before. But from thence forth, though you may continue the Parallels almost to the very Pole, yet you can make no more but foure and twentie Climes, by reason that the spaces of the Parallels towards either of the Poles do grow more narrow every one than other, so as from 66 degrees and thirtie minutes of Latitude, under which the circle Arctique palleth, the longest day is not to be counted any more by houres, but by whole dayes, weekes, and monthes, in so much as they which dwell right under the North Pole, whose Zenith is the Pole it selfe, have six months day whilest the Sunne abideth in the six Northerne Signes, and six months night, the Sunne being in the six Southern Signes. And contrariwise, they that dwell right under the South Pole have six months day, the Sunne being in the six Southerne Signes, and six months night whilest the Sun remaineth in the six Northern Signes. But because I think it a more ready way to account the length of the day by the degrees of latitude than by Climes or Parallels, I thought good heere to set downe Orontius his Table made for that purpose, which from the said 67 degrees of latitude to the North Pole agreeth in all points with the Table of Iohannes de sacro Bosco, in which Table from the said 67 degree, is not only set downe the longest day, but also what portion of the Zodiaque alwayes appeareth above the Horizon, which portion when it containeth one whole Signe, then the day is one month long, and the night as much, if two Signes, then the day is two months long, and the night as much, and so forth successively untill you come to six Signes, which is the one halfe of the Zodiaque, making both day and night each of them six months long, as I have said before, and as you may plainly see with your eye by placing the Spheare on his Horizon at every such

A Table shewing the longest day in every degree of Latitude, proceeding orderly from the Equinoctiall to the North Pole, by whole degrees without minutes from one degree to ninety.

Degrees of Latitude.	The longest day.			Degrees of Latitude.	The longest day.		
D M	H	M	S	D M	H	M	S
1 0	12	3	28	32 0	14	6	8
2 0	12	6	56	33 0	14	11	12
3 0	12	10	24	34 0	14	16	24
4 0	12	14	0	35	14	21	52
5	12	17	28	36	14	27	20
6	12	20	56	37	14	3	4
7	12	24	48	38	14	37	36
8	12	28	0	39	14	44	56
9	12	32	36	40	14	51	12
10	12	35	12	41	14	57	44
11	12	38	48	42	15	4	24
12	12	42	44	43	15	11	20
13	12	46	8	44	15	18	40
14	12	49	44	45	15	26	8
15	12	53	28	46	15	34	8
16	12	57	20	47	15	42	24
17	13	1	4	48	15	51	4
18	13	4	46	49	16	0	8
19	13	8	56	50	16	9	44
20	13	12	48	51	16	19	52
21	13	16	48	52	16	30	52
22	13	21	4	53	16	41	52
23	13	25	4	54	16	54	8
24	13	29	20	55	17	7	4
25	13	33	35	56	17	21	4
26	13	38	0	57	17	36	16
27	13	42	24	58	17	52	48
28	13	46	16	59	18	10	48
29	13	51	36	60	18	30	56
30	13	56	36				

The rest of the Table shewing the longest day in every degree of latitude, proceeding orderly from the Equinoctiall to the North Pole, &c.

Degrees of Latitude.		The longest day.			The arch of the Zodiaque alway appearing above the Horizon.	
D	M	H	M	S	o	o
63	0	19	48	40	0	0
64	0	20	24	24	0	0
65	0	21	10	32	0	0
66		22	20	40	0	0

D	M	Daies	H	M.	De.	M.
67	0	22	1	40	22	52
68	0	42	1	16	40	0
69	0	54	16	25	52	0
70	0	64	13	46	61	26
71	0	74	0	0	70	26
72		82	6	36	78	22
73		89	4	58	84	56
74		96	17	0	92	12
75		104	1	4	96	20
76		110	7	27	105	16
77		116	14	22	111	20
78		122	17	6	117	6
79		127	9	55	122	46
80		134	4	58	128	22
81		139	31	36	133	50
82		145	6	43	139	6
83		151	2	6	144	22
84		156	3	3	149	36
85		161	5	23	154	42
86		166	11	23	159	50
87		171	21	47	164	52
88		176	5	29	169	58
89		181	21	58	174	58
90		187	6	39	180	0

What things elſe do the Coſmographers teach to be conſidered in Climes and Parallels?

Divers things, as firſt how many Italian miles every clime hath in bredth and length, alſo what ſeaſons of the yeere, and what ſhadowes the Sunne yeeldeth to thoſe that dwell under divers Climes and Paralels.

What bredth and length do the ancient writers appoint to every one of the ſeven Climes?

They appoint ſuch bredth and length as this Table following ſheweth, in which alſo is ſet downe the degrees and minutes of latitude, thorow which the Middle Paralel of every Clime paſſeth, and alſo the number of miles anſwerable to one degree of every ſuch latitude.

Climes.	miles in bredth.	miles in length.	The degrees and minutes of of Latitude, thorow which the middle Paralel of every Clime paſſeth.		The number of miles anſwerable to one degree of every ſuch latitude.
			De.	M.	
1	465	20555	16	37	57
2	420	19453	24	15	54
3	370	18398	30	45	51
4	350	17299	36	24	48
5	270	16215	41	20	45
6	225	15136	45	24	42
7	195	14426	48	40	40

How is the bredth and length of every Clime to be known?

The bredth is to bee knowne by multiplying the degrees of difference contained betwixt the beginning and end of every Clime by 60 miles: And if the degrees of difference have any minutes annexed thereunto, then you muſt adde ſo many miles as there be minutes, to the product of the former multiplication. Now to have the length of every Clime, you muſt ſeeke to know by the Tables of miles, how many miles bee anſwerable to one degree of that Paralel of latitude, which paſſeth thorow the midſt of the Clime, and by that number of miles multiply 360, and the product thereof ſhall be the length.

But

But if the degree of that latitude haue any minutes annexed thereunto, then you muſt finde out the miles of thoſe minutes by the Rule of proportion, in ſaying thus: if 60 doe require ſo many miles, as you found in the Table of miles, what ſhall ſo many minutes require, and adde the quotient thereof to the product of the former multiplication, ſo ſhall you haue the true length of the Clime, all which things are obſerued in the foreſaid Table, which Table by obſerbing like order you may extend (if you will) to the number of 24 Climes ſet down by Orontius, and by diuers other modern writers.

Chap. XIX.

Of the diuers ſeaſons and ſhadowes incident to diuers Climes and Paralels, and firſt what ſeaſons and ſhadow they haue that dwell right vnder the Equinoctiall.

Thoſe that dwell right vnder the firſt Clime and eſpecially right vnder the Equinoctiall, which people at one inſtant may ſee both the Poles, haue two Summers, and two winters, for the Sunne hauing to paſſe right ouer their heads twice in the yeere, which is when hee is in Aries, and againe in Libra, then they muſt needs haue two Summers, becauſe the Sunne at both thoſe times is nigheſt vnto them, but when he is in Cancer or in Capricorne, then he is fartheſt from them, and thereby maketh vnto them two Winters. But yet neither of them ſo cold as our Winter is, whereby it appeareth that our two times of Spring and Autumn are to them two Summers, and our two times of Summer and Winter are to them two Winters.

What ſhadowes haue thoſe inhabitants?

They haue fiue ſundry ſhadowes, for when the Sunne is in either of the Equinoxes, they caſt their ſhadow in the morning when the Sunne riſeth towards the Weſt. And at night when he goeth downe towards the Eaſt, and at noone day they haue no ſhadow at all, but a perpendicular ſhadow, which

straketh right downe from head to foot, because the Sunne being then in the Equinoctiall must needs at that time of the day be right over their heads, as you may plainly see in every materiall Spheare, having a foot with a firme Horizon, and duly placed to shew a right Spheare: but when the Sun is in any place of the Southerne Signes, then the foresaid inhabitants do cast their shadow towards the North. And when he is in the Northerne Signes, they cast their shadow towards the South, and because they dwell in a right Spheare, their dayes and nights be alwayes equall.

Chap. XX.

Of the seasons and shadowes which they have that dwell betwixt the Equinoctiall and the Tropique of Cancer.

These have also two Summers, and two Winters, and 5 shadowes, like unto the others, because the Sunne passeth twice in the yeare right over their heads, first in his declining from the Equinoctiall towards Cancer, and againe in his returning from Cancer towards the Equinoctiall, under which Clime Arabia foelix is said to be situated. For Lucan writeth that the Arabians comming to Rome to aide Pompey, marvelled much to see that the trees did never cast their shadowes on the left hand, because in their Countrey their shadow is sometime on the right hand, and sometime on the left, sometime perpendicular, sometime orientall, and sometime occidentall, but in Rome and in all other places beyond the Tropique of Cancer the shadow alwayes at noone tide tendeth Northward: the words of Lucan be thus: Ignotum vobis Arabes venistis in orbem, Vmbras mirati nemorum non ire sinistras.

How is Lucan to be understood herein using this speech on the left hand?

As all other Poets are, for they having regard to the West doe alwayes make the North part their right hand, and the South part the left. But the Astronomers having regard to the South, do make the West their right hand, and the East

their

their left hand: againe, the Geographers contrariwiſe having regard to the North, do make the Eaſt their right, and the Weſt their left hand. Whereby you may ſee that the right and left hand may be taken three manner of wayes, that is according to the manner of the Poets, of the Aſtronomers, and of the Geographers.

Sith theſe inhabitants haveſeaſons and ſhadowes like to thoſe that dwell right under the Equinoctiall, wherein then do they differ?

They differ in that their dayes and nights be not alwayes equall by reaſon that their Horizon declineth from the Poles of the world. And by cutting the Parallels of the Sunne with oblique Angles it dividеth thoſe Parallels into unequall parts, neither can their two ſummers be ſo extreamely hotte as the other, becauſe the Sunne for the moſt part is further from them.

Chap. XXI.

Of the ſeaſons and ſhadowes which they have that dwell right under the Tropique of Cancer.

They have but one Summer and one Winter, by reaſon that the Sunne never palleth right over their heads but once in the yeare, and that is when he entreth into the firſt degree of Cancer: In which time when the Sunne riſeth, the ſhadow tendeth towards the Weſt, and at noone the ſhadow is Perpendicular enclining on neither ſide, but falling right downe. And at night when the Sun goeth downe, the ſhadow tendeth towards the Eaſt: and at all other times of the yeare the ſhadow at noonetide falleth alwayes Northward: and as touching their dayes and nights, they ſhorten and lengthen according as the Sunne either approcheth towards Cancer, or retireth toward Capricorne.

Chap. XXII.

Of the seasons and shadowes which they have that dwell betwixt the Tropique of Cancer, and the Circle Artique.

They have also one Summer and one Winter as we have here in England, for the Sunne never passeth right over their heads, by reason that so soone as he hath made his last and highest Parallel in Cancer, he returneth againe Southward, and therefore their shadow is never at noonetide perpendicular, but shooteth Northward, and the dayes and nights do lengthen and shorten according as the Sunne maketh his course either through the Northerne or Southerne signes. For whilest he passeth through the Northerne signes the dayes are longer than the nights, and in passing through the Southerne signes, he maketh the nights longer than the dayes.

Chap. XXIII.

Of the seasons and shadowes which they have that dwell right under the Circle Artique, and how long their day is.

They have but one Winter and one Summer, and their shadow alwayes tendeth Eastlong and Northward. And because their Zenith being in the Circle Artique, is at all times of the yeare all one with the Pole of the Zodiaque: the Ecliptique line therefore must needs be all one with their Horizon, whereby the one halfe of the Zodiaque in a very moment doth rise

above

abouē the Horiſon, and the other halfe in the ſame inſtant goeth downe. And as the whole Tropique of Cancer appeareth alwayes above the Horizon: ſo the whole Tropique of Capricorne is alwayes hidden under the Horizon. So as when the Sunne entreth into the firſt degrē of Cancer, their day is 24 houres long, and their night but a moment: ſo contrariwiſe when the Sunne entereth into the firſt degrē of Capricorne, their night is 24 houres long, and their day but a moment, as you may plainly ſee by placing the Sphere at the 66 degrē, and 30 of Latitude.

Chap. XXIIII.

What ſeaſons, ſhadowes, and length of day they have that dwell betwixt the Circle Artique and the Pole Artique.

These have like ſeaſons and ſhadowes as thoſe that dwell under the Circle Artique, ſaving that their Winter is colder and longer, becauſe the nigher they approch to the Pole, the further are they from the Sunne, and alſo have both longer dayes and nights, for the more that the Pole is elevated above the Horizon, the greater portion of the Zodiaque doth alwayes appeare above the ſame: which portion if it containe one whole ſigne, then their day is a month long, and their night as much; if two whole ſignes, then their day is two months long, and their night as much, and ſo forth as hath beene ſaid before.

Chap XXV.

Of those that dwell right under the Pole.

What seasons, shadowes, and length of day haue they that dwell right under the Pole, if there be any such people?

Truly you doe well to doubt thereof, for in mine opinion humane nature is not able to suffer the extreame cold that by reason must nedes be in those parts, neither doe I thinke that ever any man eyther Christian or Heathen did ever sayle so farre as to discover any land there. Notwithstanding if there be any such people, their season is alwaies so extreame cold as no part thereof is worthy to be called a Summer, but rather a continuall Winter, and as for their shadow vith the Sunne when he is at the highest, doth never mount above their Horizon more than 23 degrees 30. at the most, their shadow must nedes goe round about them, nigher for the most part to their fete than to their heads, for the Pole is their Zenith, & the Equinoctiall their Horizon, whereby 6 signes which is the one halfe of the Zodiaque, doth alwaies appeare aboue their Horizon, and the other halfe is alwaies hidden under their Horizon, and thereby they haue 6 moneths day, and 6 moneths night, day I say whilest the Sun is in the 6 Northerne signes, and night, whilest the Sunne is in the 6 Southerne signes, and yet the night cannot be so dark there as elsewhere, by reason that the Sunne is never distant from their Horizon above 23 degrees 30, which is onely when he entreth into the first degree of Capricorne. So likewise the day with them can never be so clere as elsewhere, by reason that the Sunne mounting no higher aboue their Horizon than 23 degrees 30, which only is when he entreth into the first degree of Cancer, hath no power to dissolue their grosse, thick, cloudie, and miskie aire, yet haue they some preeminency in that they may (if their cloudie aire be not the let) alwaies see all the fixed starrs that are placed in the sky betwext the Equinoctiall and the Pole, because they never go downe but are alwaies remaining above their Horizon: whereas in all other parts of the world, the said starres cannot be seene all at once, for that they

they both rise and set, more or lesse in number according as the Zenith of the inhabitants of every place is more or lesse distant from the Equinoctiall.

Chap. XXVI.

By what names certaine inhabitants of the earth are called as well according to the diversitie or likenesse of shadowes, as of situation.

You shall understand that according to the diversitie or likeneſſe of shadowes, the ancient Cosmographers have given to the inhabitants certaine Greeke names, whereof some are called Amphiscii, some Heteroscii, and some Periscii.

Shew what these names do signifie?

Amphiscii be those that cast their shadowes both waies, that is sometimes towards the North, and sometimes towards the South, as those that inhabite the burnt Zone.

Heteroscii be those that cast their shadow only one way, as those that dwell in either of the temperate Zones, for if they dwell in the North temperate Zone, they do cast their shadow alwaies at noonetide towards the North. And if they dwell in the South temperate Zone, they cast their shadow at noonetide towards the South.

Periscii are those that cast their shadow round about them, as those that dwell in either of the cold Zones, to whom the Pole is their Zenith: Againe, they give them certaine names according to the diversitie or likeneſſe of their situation, and of the seasons incident to those places, whereof some are called Antœci, some Periœci, and some Antipodes or Antichthones.

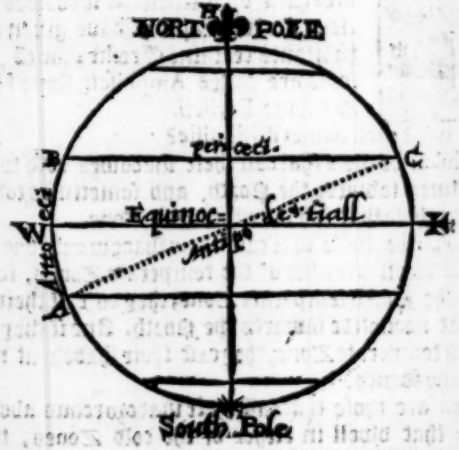
What do these names signifie?

Antœci be two severall Nations, the one dwelling towards the

the Northy Pole, and the other towards the South Pole, having one ſelfe Meridian, and one ſelfe Latitude, that is to ſay, be of like diſtance one from the Equinoctiall, the one Southward, and the other Northward, as the letters A.B. in the figure following do ſhew.

Periœci be thoſe that dwell in one ſelfe Parallel, how diſtant ſoever they be Eaſt and Weſt, as the letters B.C. in the following figure do ſhew.

Antipodes be thoſe that dwell fæt to fæt, ſo as a right line, being drawne from one to another, palleth through the Center of the world, as you may ſee by the letters A.C. in the figure following.



And the firſt of theſe called Antœci have contrary ſeaſons of the yære, for when it is Summer to the one, it is Winter to the other: Againe Periœci, though they have like ſeaſons of the yære, yet becauſe they are ſo farre diſtant in length one from another, it is therefore mid-day to the one when it is mid-night to the other. But Antipodes be contrary in ſeaſons

ſons and in all other things, having nothing common, more then that they have one ſelfe Horizon.

Chap. XXVII.

By what names certaine parts of the earth are called by reaſon of their divers ſhapes.

Now beſides the foreſaid names attributed to the inhabitants of the earth for ſuch reſpect as is aboveſaid, the Coſmographers do give alſo to divers parts of the earth according to the divers ſhapes thereof divers names alſo: for if any part of the earth be inuironed round with water either ſalt or freſh, it is called Inſula, that is an Iland, as England, Ireland, and ſuch like: but if the water go round about it ſaving in one part, then it is called Peninſula, that is to ſay, almoſt an Iland, as Denmarke, Italy, Horia, and ſuch like: and if it be a narrow ſtraight incloſed with the Sea on both ſides, then it is called Iſthmus, as the narrow ſtraight of Corinth lying betwixt Boetia and Achaia in Græce which divers Emperours of Rome have in vaine attempted to cut, to the intent to make therethrough a navigable paſſage: finally, when it is neither Inſula, Peninſula, nor Iſthmus: then it is called Continens, that is to ſay, firme land, as Saxony, Boemia, Suevia, and ſuch like, but theſe bee ſpeciall Continents, for the Coſmographers of theſe dayes do make but three generall Continents, that is firſt ſo much as was knowne to Ptolomie, and the reſt of the ancient writers, ſecondly the Weſt Indies lately found out, and thirdly the South part of the world not yet wholly diſcovered: Againe the ancient men divided that portion of the world, which was knowne in their dayes into three parts, that is, Europe, Aſia, and Africque, whereunto the moderne writers have added a fourth part called America, containing the Weſt Indies. Now if you would know what Kingdomes, Regions,

Cities, Townes, Seas, with their Hauens, Ports, Bayes, and Capes, Iſles, Floods, Parithes, and Mountaines, are contained in euery one of theſe foure parts, then peruſe often the univerſall Mappes, and Terreſtriall Globes, as well of the moderne, as of the ancient writers, and alſo the Tables of Ptolomie, and of Ortelius, which I wiſh that they had bene made in ſuch ſorme as the Tables of Ptolomie are: for having the North alwayes ſet in the Front, it ſhould be the readier to compare the ſhape or ſituation of any place or Region to the univerſall Mappe, and by knowing the Longitude and Latitude of any place, it ſhould be the eaſier to find the ſame, as well in the ſpeciall Tables as in the univerſall Mappe or Globe. The uſe of which univerſall Mappes, I haue already written in a ſeuerall Treatiſe by it ſelfe printed not long ſince. But now for ſo much as the knowledge of the Winds hath bene alwaies thought a thing meete to be treated of by him that writeth of Coſmography, and ſpecially of the Spheare, I will here ſpeake ſomewhat of them, neither do I mind to make any great diſcourſe thereof, as naturall Philoſophers are wont to do, but only to define what the mind is, and to ſhew into how many parts the ſame is diuided, as well by the ancient and moderne writers, and by what names they are called, and ſomewhat of the qualities thereof.

Chap. XXVIII.

Of the Wind, what it is, what motion it hath, and of the diuers names and diuiſions thereof.

FIrſt then you haue to vnderſtand that Ariſtotle and the reſt of his ſect, do define the Wind to be an exhalation hotte and dry, engendred in the bowels of the earth, and being gotten out, is carried ſidelong upon the face of the earth.

Why

Why is not his motion right vp and downe, as well as side-long?

Because that whilest by his heate he striueth to mount vp, and to passe through all the three Regions of the ayre, the middle Region by his extreame cold doth alwaies beat him backe, so as by such strife, and by the meeting of other exhalations rising out of the earth, his motion is forced to be rather round than right.

What is the cause why hee bloweth more sharply at one time than another, and in one place more than another, and sometime not at all?

As the fumes that rise of new exhalations, and out of clouds and waters, may encrease his force, so lacke of heat and fumes doth diminish the same. Againe, the roundnesse of the earth is cause that he bloweth sometime more in one place than in another: also Mountaines, Hilles, and great Woods may hinder his force in some place of the earth, whereas vpon the plaine, or vpon the broad Sea he bloweth most sharply: and as for his not blowing at all, it may chance diuers waies, as either for lacke of sufficient heate to open the pores of the earth to let himselfe out, or for that some extreame frost and cold doth close the pores of the earth so straite that he cannot get forth, or for that the Sunne with his extreame heate consumeth the fumes and vapours that should maintaine him. But leauing to answere any more to these questions, I will shew you how many windes were obserued by Saylers in old time, and how many are obserued at this present day, and how they were named. True it is that all Nations doe agree in placing the foure principall windes, according to the foure quarters of the Horizon or Angles of the world, that is to say, East, West, North, and South: but in the subdiuision of the said foure quarters they differ, for some diuide euery quarter of the Horizon into two, making onely eight windes, and some into three, and thereby doe make twelue windes, which the ancient Grecians and the Romanes did chiefely obserue. The names of the eight windes are commonly expressed in the Italian tongue thus: Thramontano, North,

Mezzodi.

Mezzodi, South, Levante, East, Ponente, West, Griego, Northeast, Garbino, Southwest, Maistro, Northwest, Syrocho, Southeast, which names are often used by Christopher Columbus, Albertus Vesputius, and others that sailed first into the East and West Indies: and if you will know the names of the twelue Winds used by the ancient Grækes and Romans, then behold this figure here following wherein you shall find them set downe in English, Græke, and Latine, that is to say, the English names without the Circles, and the Græke and Latine names within the Circle, the Græke upon the right side of every line pointing the Wind, and the Latine name upon the left side of every such line.



of

Chap. XXIX.

Of the nature and qualities of the foreſaid twelve Windes.

THE North winde called Septentrio or Aparctias is extreamely cold and drie, prohibiting raine, it preſerueth health by cleanſing the ayre of all peſtiferous infections, but it cauſeth dry colds, and hurteth the fruites and flowers of the earth.

2 The Northeaſt and by North, called Aquilo or Boreas, is alſo cold and dry without raine, it hurteth the flowers and fruits of the earth, and eſpecially the Vines when they budde.

3 The Northeaſt and by Eaſt, called Helleſpontus or Caecias, is hotte drying vp all things.

4 The Eaſt wind called Subſolanus, is hotte and drie, temperate, ſweete, pure, ſubtill, and healthfull, and ſpecially in the morning when the Sunne riſeth, by whom hee is made more pure and ſubtill, cauſing no infection to mans bodie.

5 The Eaſt Southeaſt, called Eurus or Vulturnus, is alſo hotte and drie, he bloweth lowd, and therefore is called of Lucretius, Altitonans Vulturnus.

6 The Southeaſt and by South called Euroaſter, or Euronotus, is hotte and moyſt, and breedeth cloudes and ſickneſſe.

7 The South wind called Auſter, or Notus, is hotte and moyſt, breeding thicke cloudes, great raines, and peſtiferous ayre.

8 The Southweſt and by South called Auſtro Aphricus, is temperately hotte, and yet breedeth ſickneſſe, and raine, as ſome write.

9 The Southweſt and by weſt, named Aphricus or Libs, is cold and moyſt, cauſing raine.

10 The

10 The West Wind called Favonius, or Zephirus, is temperately hotte and moyst, and wholesome in the evening, it dissolveth Frost, Ice, and Snow, and maketh Flowres and Gralle to spring, and some write, that it causeth thunder.

11 The West Northwest called Corus or Cyrus, is cold and moyst, without any great rigour.

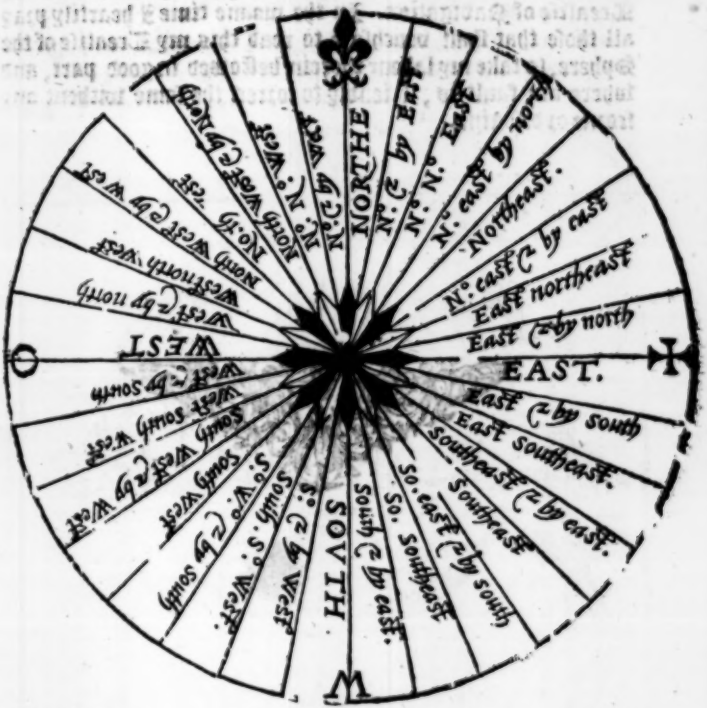
12 The Northwest and by North, called Syrus or Trachias, is cold and dry, of earthly nature, bringing Snow and Winds.

Chap. XXX.

Of the moderne division of the Winds.

But the Marriners of these our later dates, to bee the better assured of their Rents and Courses on the Sea, do divide every quarter of the Horizon into eight severall Winds, so that they make in all two and thirtie Winds, which of the Spaniards are called Rumbes, which Winds together with their names, you may see plainly set forth in this figure following, representing the Marriners Compasse.

A Figure of the 32 Winds representing the Marriners Compasse.



And note that eight of these Winds are called principall Winds, that is South, North, East, West, Northeast, Southwest, Northwest, and Southeast, and all the rest are called Collaterall winds, but the first foure are chiefest, from whence the names of all the rest are derived, neither do the learned Pilots in their Tables call the first foure winds, Rumbes, but

will

will ſay the firſt, ſecond, or third Rumbe from North, from Eaſt, South, or Weſt, unto the number of ſeuen, for ſo many Rumbes they make in euery quarter betwixt the foure chiefe and principall winds, of which matter I ſhall ſpeake hereafter in my Treatiſe of Nauigation. In the meane time I heartily pray all thoſe that ſhall vouchſafe to read this my Treatiſe of the Sphere, to take my labour therein beſtowed in good part, and where any fault is, friendly to correct the ſame without any ſcorne or diſdaine.



A

A plaine deſcription of *Mercator* his two Globes, that is to ſay, of the Terreſtriall *Globe, and of the Celeſtiall Globe, and of either* of them, together with the moſt neceſſary uſes thereof, written by M. *Blundevill.*

Whereunto is added a briefe deſcription of the two great Globes lately ſet forth by M. *Molinaxe*: and of Sir *Francis Drake* his firſt voyage *into the Indies.*

ZENITH.



He telleth the number of the Starres, and calleth them by their names. Pſal. 147.

Imprinted at London by *Richard Biſhop*. 1636.



A plaine description of the two Globes of Mercator, *that is to say, of the Terrestriall Globe,* and of the Celestiall Globe, and of either of them, together with the most necessary uses thereof, and first of the Terrestriall Globe.

written by M. Blundevill.

THe Terrestriall Globe is a round bodye couered without vniuersall Mappe containing both Sea and Lande, which is diuided by the later Cosmographers into fiure principall parts, that is, Europe, Affrique, Asia, and America, the Longitude and Latitude of euery which part is already set downe in my description of vniuersall Mappes and Cardes. And in this Globe are also sette downe certaine starres, some towardes either of the Poles, and some nigh to the Ecliptique line, whereof we shall speake hereafter when we come to treat of the Celestiall Globe. But you haue to vnderstand that the one end of this Globe is called the Pole Artique, that is to say, the North Pole, and the other end, the Pole Antartique, that is to say, the South Pole: upon which two Poles it is turned about. And this Globe is traced with certaine circular lines, whereof some be greater and some lesse, the greater which passe throwh both the Poles, are called Meridians of this word Meridies, which is as much to say as noone tide, for when the Sunne toucheth any of those Circles, it is noone tide to all those that dwell right vnder that Circle, of which Meridians though you may imagine to be sette so many as

there be [illegible] to the number [illegible] no more but twelue [illegible] the Equinoctiall in 24 points, making thereby 24 ſpaces, euery ſpace containing 15 degrees of the Equinoctiall, which 15 degrees doe make one houre: for the Equinoctiall is a great Circle, which girding the Globe in the very middeſt betwixt the two Poles, and repreſenting the motion of the firſt moueable, moueth his dayly reuolution from Eaſt to Weſt in foure and twenty houres. And this great Circle by deuiding the Globe into two equall parts cauſeth the ſame to haue two Latitudes or breadthes, the one Northerne, and the other Southerne, for that ſpace of the halfe Globe which lieth betwixt the Equinoctiall and the North Pole, is called the North Latitude, and the other halfe of the Globe which lieth betwixt the Equinoctiall and the South Pole, is called the South Latitude, euery Latitude containing euery where from the Equinoctiall to either of the Poles ninetie degrees. Againe this Circle is deuided into 360 degrees containing the whole Longitude of the earth, and euery degree is 60 Italian miles, which being multiplied into 360 maketh in all 21600 miles, and the Longitude is to be counted from Weſt to Eaſt, beginning the ſame at the firſt Meridian which paſſeth through the Iles of Canaria, otherwiſe called Inſulæ Fortunatæ, croſſing the Equinoctiall and the Ecliptique line, in the firſt degree of Aries, and alſo in the firſt degree of Libra, which are the two Equinoctiall points: ſo as the one halfe of the Equinoctiall which goeth from Weſt to Eaſt, containeth 180 degrees, and the other halfe returning againe from Eaſt to Weſt containeth alſo 180 degrees, which maketh in all 360 degrees, ending where the firſt degree of Longitude did beginne: for though Mercator and others in their ſeuerall Mappes doe in theſe dayes name the firſt Meridian to paſſe through the Iles Azores which are fiue degrees more to the Weſt. Yet Metcator in his great terreſtriall Globe dedicated firſt to the Lord Grenuelle, and afterwards to the Emperour Charles the fift, Anno Domini 1541, placeth the firſt Meridians before ſaid;

both,

both whole Globes my verie honest friend Sir Thomas Knyver of Ashwelthorp Knight, did courteously lend me, I thanke him, who as hee is very well learned in all liberall Sciences himselfe, so he is a great cabourer and furtherer of all such as delight in any learned or vertuous exercise. And by the helpe of those Globes I wrote this Treatise. But to returne to my matter, there is another great Rooping and overthwart Circle, called the Ecliptique line, under which the Sunne continually walketh, and this line is marked with the Characters of the twelve signes, every signe containing in length thirtie fiue degrees as the Equinoctiall hath, so as in all, the Ecliptique line containeth 360 degrees, which is the Longitude of heaven, and the first degree of the Longitude of any Starre beginneth at the first point of Aries, and endeth at the same point. Now of the lesser Circles there be foure principall, that is, the fiue Tropiques, that is to say, the Tropique of Cancer towards the North Pole, and the Tropique of Capricorne towards the South Pole, betwixt which two Tropiques the Sunne continually keepeth right under the foresaid Ecliptique line, neuer ascending higher than the Tropique of Cancer, or descending lower than the Tropique of Capricorne. Of the other two lesser Circles, the one is called the Circle Arctique environing the North Pole, and the other the Circle Antarctique environing the South Pole: all which foure Circles are called Parralels, that is to say, equally distant one from another, and by reason of these foure Circles, the Globe is diuided into fiue Zones, that is to say, two cold Zones, two temperate, and one extreamely hote: of the cold Zones, the one lyeth betwixt the Circle Antarctique and the South Pole, and the other betwixt the Circle Arctique and the North Pole.

And of the temperate Zones, the one lyeth betwixt the Tropique of Cancer and the Circle Arctique, and the other lyeth betwixt the Tropique of Capricorne and the Circle Antarctique. The torrid Zone is that which lyeth betwixt the

two Tropiques, through the middest of which Zone passeth the foresaid Equinoctiall line, right under which, they that dwell have no Latitude at all, and therefore their daies and nights are alwaies equall, (that is to say) twelue houres day, and twelue houres night. Also besides the foure foresaid lesser Circles or Parallels, the Globe is traced with eight other Parallel Circles on each side of the Equinoctiall towards either of the Poles, making on each side nine equall spaces, every space containing tenne degrees of the Equinoctiall, so as they do make in all 90 degrees, which is a quarter of the great Circle. Moreouer there be certaine Mariners Compasses diuided into 32 circular lines signifying the 32 windes, whereby the Mariners doe saile, and doe direct their ships from port to port, which lines doe diuerly crosse the other Circles before rehearsed. Besides these Circular lines before described, there is fastned into the two Poles of the Globe, a Meridian of Brasse commonly called the moueable Meridian, within the which the Globe turneth about, and this Meridian is diuided into foure quarters, euery quarter containing 90 degrees, so as the whole circuit thereof is 360 degrees, one of which quarters towards the North Pole is diuided with circular lines into foure seuerall spaces, in the first and lowest whereof being next to the bowle of the Globe, are set downe the numbers of degrees of Latitude. In the next space aboue that, are grauen the Parallels and numbers of houres of the longest day in euery Latitude, and the spaces of euery houre are diuided with little strokes into foure parts, signifying the foure quarters of an houre: and these houres doe increase till you come to 24 houres, and from thence the day increaseth by moneths, from one to fiue, aboue which is graben this Latine word Menses, (that is to say) moneths, and the third and vppermost space containeth the Climes, beginning at one, & so proceeding to eight. The like Climes, Parallels, and houres of the longest day are to be accounted also in the said brazen Meridian proceeding from the Equinoctiall towards the South Pole, though they be not there set downe. And vpon this brazen Meridian is placed at the North pole

another

another little brazen Circle together with his Index called the houre-wheele every halfe whereof containeth twelve houres, the Index of which wheele being set upon the North Pole turneth about as the Globe turneth, and yet you must imagine the Pole it selfe to be immovable. Also there is a quarter Circle of thinne Brasse plate, divided into 90 degrees fastned in such sort upon the Brazen Meridian, as you may remove it to and fro, yea and also take it cleane off if you will, which quarter Circle hath a square head of Brasse, signifying the Zenith or universall point of any place, and this Circle is called the Quadrant of altitude, which Quadrant is divided into 90 degrees, proceeding from the Horizon upward to the Zenith, whereby may be described upon the Globe the 90 Almicanterathes or Circles of Altitude. And this Quadrant serveth for divers purposes, as to find out thereby the Altitude of any Starre or point of the Ecliptique line, or in any other point in heaven, and the very edge thereof on the right hand, sheweth the Azimuth or vertitall Circle of any place, and in what coast and part of heaven any Starre is. Also how any place of the earth beareth one from another, as you shall more plainly perceive hereafter by the examples of certaine Propositions thereto belonging. Then there is another Circle of Brasse plate somewhat thicker called the Semi-Circle of position, which serveth chiefly for matters of Astrologie, as to find out the twelve houses of heaven, and is to be fastned on the Horizon, so as it may be removed and set upon which side of the Globe you will. Also there belongeth to the Globe a little round Squire of Brasse, made with right Sphericall Angles, the head or stile whereof is to shew the shadow of the Sunne being set upon the Globe, in stead whereof a Needle being set right up, will sometimes serve the turne. Finally to the Globe belongeth another Circle called the Horizon, which is a broad Circle of wood, having a foot of wood, within which Horizon, the Globe together with the Brazen Meridian is to be set at what Altitude you list. And this Horizon is divided with divers circular lines into seven unequall spaces, whereof the first & narrowest

space next vnto the body of the Globe, containeth the degrees of the 12 signes of the Zodiaque, every signe containing 30 degrees. The second space containeth the Characters, and names of the said signes, & also the number of the degrees, as 10, 20, 30. The third, the dayes of every month. The fourth, the names of every month, and of certaine Feastiuall dayes. The fifth, the names of the twelue winds, which the ancient Greekes and Romanes were wont to obserue, whereof I haue already spoken in my Spheare. The sixth & seuenth do shew the twelue houses, together with their significations necessary for the setting of figures, & calculating of nativities; & in the fot of the said Horizon is a little Compasse with a needle to shew the North and South, according to which the Globe is to be placed. But yet not before the said needle be truly rectified, according to the variation which it hath in that place where you are to use the Globe: for otherwise the needle may cause great errour, whereof we shall treat in the next Chapter. Thus having briefly described the Terrestriall Globe, and all the parts thereof, I thinke it good now to shew you how to place the Globe according to the foure quarters of the horizon.

This

This Treatise of the two Globes containeth 50 Propositions, as followeth.

HOW to place the Globe truly, according to the foure quarters of the world, and according to the Latitude of any Region. Proposition 1.

To know under what Clime any place or Region is, and how many houres the longest day is there, and also what Latitude any place described in the Mappe hath. Prop. 2.

How to know what Longitude any place described in the Mappe hath. Prop. 3.

How to know the distance betwixt any two places described in the Mappe. Prop. 4.

To know how one place beareth from another. Prop. 5.

How to find out by the Globe the place of the Sunne, that is to say, the degree and minute of that signe wherein the Sunne is every day throughout the yeere. Prop. 6.

How to rectifie the Index of the houre-wheele for every severall day throughout the yeere. Prop. 7.

How to know every day at what houre the Sunne riseth or setteth. Prop. 8

How to know in what part of the Horizon the Sunne riseth and setteth euery day. Prop. 9.

How to know the length of every day and night throughout the yeere, as well by helpe of the houre-wheele, as by counting the degrees upon the Horizon. Prop. 10.

How to know by the Globe how much the Sun declineth every day throughout the yeere from the Equinoctiall. Prop. 11.

How to know by the Globe the Meridian Altitude of the Sunne, that is to ſay, his height at noone-tide every day throughout the yeere, and how farre he is then diſtant from your Zenith: Prop. 12.

How to know the Altitude of the Sunne at every other houre of the day. Prop. 13.

How to know the houre of the day by the Globe. Prop. 14.

To know how much the unequall houres otherwiſe called the Planetarie houres, do differ from the artificiall houres throughout the yeere, and how many minutes every unequall houre containeth. Prop. 15.

How to know every day when the dawning of the day, and the twilight of the night beginneth and endeth, and the time of their continuance. Prop. 16.

How to know the aſcention of the Sunne, both right and oblique. Prop. 17.

The 18 Propoſition, containing the deſcription of the Celeſtiall Globe, and ſhewing wherein it is like or differing from the Terreſtriall Globe.

The 19 Propoſition, containing a particular deſcription of the 48 Images of the fixed Starres that are in the Celeſtiall Globe, together with their ſundry names, and alſo the names of ſo many Starres as are named in the Globe. Prop. 19.

How to find out in heaven any unknowne Starre deſcribed in the Globe two manner of wayes, that is, either by the helpe of ſome knowne Starre, or elſe by knowing the true houre of the night. Prop. 20.

How to know by the Globe the Meridian Altitude which is the higheſt Altitude of any Starre, and how high or low he is at any other time. Prop. 21.

How to know by the Globe what Starres are above the Horizon at any time of the day or night. Prop. 22.

How to know by the Globe at what time any Starre riſeth above the Horizon, mounteth to the higheſt, and ſetteth: and with what degree of the Ecliptique he riſeth, mounteth, and ſetteth; and alſo in what part of the Horizon hee riſeth and ſetteth. Prop. 23.

How

How to know in what part of the firmament any Starre is, and how many degrees it is diſtant from the Meridian at any houre, and being right under the Meridian to know how farre it is diſtant from your Zenith. Prop. 24.

How to find the houre of the night by the Globe. Prop. 25.

How to know the verticall Starres in every Latitude. Prop. 26

How to know the true place of any Star, that is to ſay, in what ſigne, and in what degree thereof any Starre is. Prop. 27.

How to find the place and Longitude of any Starre by the Globe. Prop. 28.

How to find the Latitude of any Starre. Prop. 29.

How to find out by the Globe, the declination of any Starre, Prop. 30.

How to know the magnitude or greatneſſe of any Starre, and his nature and quality by the Globe, and alſo the right aſcention of the Arke of the Ecliptique, which accompanieth the right aſcention of any Starre. Prop. 31.

A Table of the fixed Starres.

How to find out the right and oblique aſcention of any Starre, and alſo of the aſcentionall difference. Prop. 32.

To know in what quantity of time any whole ſigne, or any other Arke of the Ecliptique doth riſe or ſet. Prop. 33.

How to know by the Globe what Starres do riſe or ſet every day Coſmically, Acronically Heliacally. Prop. 34.

To know in what time of the yeere any Starre riſeth or ſetteth either Coſmically or Acronically. Prop. 35.

Of the Horoſcope and the reſt of the 12 houſes. Prop. 36.

How to find out the Horoſcope or aſcendent at any time of the day or night by the Globe, and thereby to know the foure principall Angles of heaven. Prop. 37.

How to erect a figure by the Globe according to *Regio Montanus* his way, which is called the reaſonable way, and is counted beſt of all others. Prop. 38.

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Another way to find the elevation of the Pole. Prop. 40.

A third way how to find out by two Starres the elevation

of

of the Pole, not knowing their Meridian Altitude. Prop. 41.

A fourth way to find out the Latitude of any Region by any knowne fixed ſtarre or Planet that may be ſeene. Prop. 42.

A briefe deſcription of the diurnall Table ſet downe in *Stadius* his Ephemerides, together with the vſe thereof. Prop. 43.

How to find out the place of any Planet by the Ephemerides. Prop. 44.

A briefe deſcription of the Table of *Stadius*, ſet downe in the 112 Page of his Ephemerides, to find out thereby the daily Latitude of the Moone be it North or South, together with the Canon or Rule thereof, plainly declared by example. Prop. 45.

How to know the true place of the Sunne or Moone, or of any other Planet, every houre of the day throughout the yeere. Prop. 46.

How to find out the place of the Moone by the Globe when ſhe is above the Horizon, without the helpe of any Ephemerides or other Table whatſoever. Prop. 47.

Another way to find out the place of the Moone without taking the Latitude of any Starre. Prop. 48.

How to find out the Longitude of any Region. Prop. 49.

Another way to find out the vnknowne Longitude of any place by the Globe. Prop. 50.

The

The uſe of the Globe.

Propoſition. I.

How to place the Globe truly according to the foure quarters of the world, and according to the Latitude of any Region.

Firſt ſo ſit your Globe together with the Brazen Meridian in the two nicks of the Horizon, and alſo in the ſlit of the pin which ſtandeth in the midſt of the foot, ſo that the North Pole of your Globe be anſwerable to the North quarter or North wind of the world, deſcribed upon the Horizon, and ſee that that part of the Brazen Meridian, wherein are deſcribed the Climes, Parallels & houres of the longeſt day, may ſtand above the Horizon, and alſo that the one halfe of the brazen Meridian may juſtly & evenly appeare above the Horizon, & the other halfe under the Horizon: Againe, you muſt ſee that the Equinoctiall line of the Globe do meet juſt with the middle point or Creek of the Brazen Meridian, whereas the firſt degree of Latitude doth begin, and alſo that the body of the Globe do not leane to the one ſide of the Horizon more than to the other, but to be equally diſtant from the ſame in all places, and in any wiſe to ſee that the Horizon ſtand alwayes levell, to which end ſome Globes habe a plummet of Lead hanging by a little chains of thred, which becauſe it will move with every wind, I for my part do thinke it better for you to habe ſuch a little levell made of purpoſe, as you may ſet the ſame upon any place of the Horizon where you liſt, and thereby make the



Horizon

Horizon to stand levell on every side as you will your selfe, and it may be made of a little peece of thick boord, like a Triangle, as the former figure demonstrateth.

Then with your two hands laying hold of the two next pillars, turne the foot of the Globe untill it stand right North and South which, is to be done thus: First find out the true Meridian of the place whereas you are to use the Globe by such meanes as Master Borrough teacheth in his discourse of the variation of the Compasse, the 7 Chapter, which undoubtedly is a most certaine way, by which you shall find three things at one instant, that is, the true Meridian, the variation of the Needle, and the true Latitude of any place. But if you haue not the instrument of variation, by helpe whereof this matter is to bee accomplished, then in some open place betwixt eight and nine of the clocke in the forenoone or sooner, upon a smoth Table or Planche standing levell, draw a good large Circle with your Compasses, in the Center whereof must be fixed a round and straight pinne of Iron or Latten wire, in length a good deale higher then the Semidiameter of that Circle, and to the intent that the pinne or stile may stand right up, without inclining on either side, it would be rectified by a true Squire: That done, wait diligently untill the shadow of the pin head do iustly touch the Circumference of the Circle, so as it neither passe beyond the Circle, nor come short of the same, and there make a pricke, and so let it stay untill about three of the clocke in the afternoone, about which time the shadow of of the pinne will beginne to approch nigh unto the said Circle, and so soone as it toucheth the same, make there another prick: that done, divide the Arch or portion of the Circle contained betwixt those two prickes into two equall parts, and in the midst thereof set another pricke, then laying your Ruler to the middle pricke, and to the Center of the Circle, draw a right line thorow the Center, and also thorow the middle prick from the one side of the Circle to the other, and beyond if you list: for you may make the said line of such length as you shall thinke most meet to serue your turne, and that line shall be the true Meridian for that place, the which the right North

and

and South part of your Horizon, and by crossing the said line with another right line in the meridian with right Angles you shall haue the true East and West, and in about long waiting, you may draw diuers Circles one within another thus hauing found the true North and South East and West, place your Globe accordingly, and the brasen Meridian of the Globe may answere the Meridian line thus drawne vpon the boord or plancke, and to the intent that afterward you may know at all times both day and night, how to place your Globe right North and South, it shall be necessary to draw a right line vpon the foot of the Horizon, answerable to the foresaid Meridian first drawne vpon the boord or plancke, and vpon that line to fasten a pretty handsome Compasse, hauing a Needle at an inch long at the least, which is much more certaine, than such a little Needle as is wont to be set in the foot of euery Globe. And when the Needle standeth still, mark how much the North point thereof declineth either East or West, from the true Meridian before taken, and whereas you see the Needle to decline, be it East or West, there set fast a little pin of Latten to serue as a marke, whereto you may alwayes direct the North point of the Needle when you would haue the Globe to stand right North and South, for there is no Needle touched with the load stone, be it neuer so good a stone, but it will vary from the true Meridian line, either more or lesse, and therefore no trust is to be given to the Needle vntill you know the true variation thereof, the finding of which variation, as I said before, is most truly taught by M. Borough in his Booke before mentioned, whereunto I once againe referre you, and the rather for that it is written in our mother tongue. But Gemma Frisius teacheth to set the Globe right North and South thus, first go into an open place where as the Sunne shineth, and vpon some table standing leuell, and also the Globe standing leuell, the Pole being elevated aboue the Horizon according to your Latitude, fix a straight Needle in the degree of the Signe wherein the Sunne is that day, so as the Needle may stand right vp without inclining any manner of way, and if it be in the forenoone, turne the East side of the

Globe

Globe towards the South, moouing both the Quadrant and the sent to and fro, vntill you finde the Sunne truely vpon the Meridian at all, for so shall the Globe stand right North and South. But if it be in the afternoone, you must turne the Westerne part of the Globe towards the South, and then worke as before, and so by any of these rules before taught, you shall not only place the Globe answerable to the foure quarters of the world, but also you shall find that the Circles, Poles, and Aspectes of the Globe are answerable to the Circles, Poles, and Aspectes of the heauens. Now hauing placed your Globe answerable to the foure quarters of the world, learne to finde by some Ta-ble or moderne Poppe, or else by such rules as are set before both in the Sphearе, and also in the later end of this Treatise, the Latitude of the Region wherein you dwell. As for exam-ple, the Latitudes of these parts here about Norwich is 52 de-grees, then taking hold of the brazen Meridian as well with your left hand aboue the Horizon, as with your right hand be-neath the Horizon, turne the same vp and downe in the nicks of the Horizon, vntill the North Pole be elevated aboue the Horizon 52 degrees, the last of which degrees must meet euen with the vpper brimme of the Horizon, that done, seeke for England in the Globe, not ceasing to turne the body of the Globe to and fro, vntill you haue brought that Meridian which passeth through England right vnder the brazen Meri-dian, and holding it still at that stay, draw the head of the brazen Quadrant of Altitude right over the place, and ouer that Meridian vnder which you dwell, so shall the head of your brazen Quadrant stand for your Zenith in the very midst of the Horizon, and keeping all things thus at a stay, you may le-hold euery Region or Country is situated, and how it beareth from you, and which be vnder your Climate, and which be not: and to be sure that the brazen Zenith may stand in his right place, it shall be needfull to set it so as the left square fine thereof made with a long notch, may touch the selfe same degree of Latitude in the brazen Meridian, which it hath of Altitude, for look how many degrees the Pole is elevated aboue the Ho-rizon, which for alled the Altitude, so many degrees must the

brazen

ſtrength. Which be not ouer from the Equinoctiall of the Globe, ſeuerall vnto all the Latitudes, and in the reſt one with the Latitude of the Pole. Thus hauing ſhewed you how to place the Globe according to the ſeuerall quarters of the world, I think good now to declare vnto you, firſt the vſes of the Terreſtriall Globe, whereof ſome are common alſo to the Celeſtiall Globe: as you ſhall be taught hereafter in the propoſitions following, which propoſitions may be very well deuided into three ſorts, whereof the firſt do properly belong to the deſcription of the vniuerſall Mappe, wherewith the Terreſtriall Globe is couered, which are but few in number. The ſecond kind of propoſitions do chiefly belong to the Sunne, and to his apparances which are alſo common to the Celeſtiall Globe, and may be found out by either of the Globes. But the third kind do belong moſt properly to the fixed Starres, and to their apparances, and therefore I mind not to ſet downe them vntill I come to deſcribe the Celeſtiall Globe, and to ſhew the vſes thereof.

The chiefeſt propoſitions belonging to the vniuerſall Mappe, wherewith the terreſtriall Globe is couered, are theſe following

PROPOSITION II.

To know vnder what Clime any place or Region is, and of how many houres the longeſt day is there, and alſo what Latitude any place deſcribed in the Mappe hath.

HAuing ſet the Globe at your Latitude, bring the place or Region which you ſeeke right vnder the brazen Meridian, and the vpper ſpace of the ſaid Meridian will ſhew the Clime. And the ſecond or middle ſpace will ſhew the houres of the longeſt day. And the third ſpace the Latitude: As for example, if you would know vnder what Clime London is, then hauing found London, fix a long needle in the red ſpot next to the name of London (for all townes for the moſt part in the Globe are marked with red ſpots) that

that done, turne the Globe softly with your hand vntill the Pricke do touch the 51. in Cornwall, and by staying the Globe there with your hand, you shall find London in the third Clime, and that the longeſt day in the yeare is there 16 houres and 30 minutes, and the shire and nethermoſt ſpace both the two the Latitude of the place which is 51 degrees, 30. Againe, by obſerving this order without chaunging your Latitude, you shall find Venice to be vnder the 5 Clime, and the longeſt day to be 15 houres and some what more, and the Latitude of that Clime is 44 degrees, 30. and you shall find Ieruſalem to be vnder the third Clime, and the longeſt day there to be 12 houres, and the Latitude thereof to be 32 degrees, 30.

PROPOSITION III.

How to know what Longitude any place deſcribed in the Mappe hath.

THe Globe ſtanding ſtill at your owne Latitude, prick the Needle in the place whereof you ſeek the Longitude, and bring it as before to the brazen Meridian, and ſtaying it there, looke at what number of degrees the brazen Meridian cutteth the Equinoctiall, and that is the Longitude of the place, counting the degrees from the firſt degree of the Equinoctiall, which beginneth at the firſt point of Aries vnto the place of the ſection: by doing thus, you shall find the Longitude of London to be 19 degrees, and the Longitude of Venice to be 36 degrees, and the Longitude of Ieruſalem to be 67 degrees and 30 minutes.

How

Proposition. IIII.

How to know the distance betwixt any two places described in the Mappe.



Open your Compasses so wide that you may set the one foot thereof just in the one place, and the other foot in the other place, and apply that wideneſſe to the Equinoctiall line, counting how many degrees of the Equinoctiall are contained betwixt the two feet of your Compasses, and by allowing to every degree 60 miles, you shall have the true distance of the places. Thus you shall find the distance betwixt London and Venice to be 13 degrees, 30′, which being multiplyed by 60, maketh 810 miles, and the distance betwixt London and Ieruſalem to be 40 degrees, 30′, which being multiplyed by 60, maketh 2430 miles. And it maketh no matter to what part soever of the Equinoctiall you do apply the wideneſſe of your Compasses, so as you set the first foot at the very beginning of some one degree, and let the other foot fall out as it will, either at the whole degree, at a halfe, or at a quarter of a degree, which small parts are to be counted by minutes by conjecturall discretion. And note here that no two places can be distant one from another East and West more then 180 degrees, which is just the one halfe of the circuit of the Earth, beyond which halfe, or on this side thereof the places must needs be nearer together by meanes of the rowndneſſe of the earth, and if either of the two places whereof you would know the distance be not expreſſed in the Globe, then learne to find out the Longitude and Latitude thereof by some Table, whereof the first Meridian is supposed to passe through the Ilands of Canaria, and marke upon the Globe where the said Longitude and Latitude do crosse, for there ought that place to stand which is missing, to which place direct the one foot of your Compasses, and then worke as before is taught. And by this meanes you may also know the distance betwixt any two Starres, contained in the Globe.

Proposition. V.

To know how one place beareth from another.



Though you may partly find out this by marking the direction of the lines, proceeding from the Mariners Compasse set downe in the Globe: yet in mine opinion it is readier to do it by applying the Flie described in my little Treaty of universall Maps, unto the Globe, by setting the Center thereof upon the first place from whence you go, and by drawing a thred thorow that place whereto you would go, in such order as is there taught. So you shall find Venice to beare from London South East and by East, and Jerusalem to beare from London East, South East, and two quarters more towards the South. But Gemma Frisius teacheth to know by the Globe how one place beareth from another, thus: having set the Globe and also the Zenith of the Quadrant of Altitude at such Latitude as the first place or Region hath, from whence you would go, lying that first place under the Brazen Meridian, and there stay the Globe untill you have brought the Quadrant of Altitude to the second place, and the nether end of the Quadrant of Altitude will shew you upon the Horizon among the winds, how the second place beareth from the first: so shall you find Hispaniola to beare from Spaine right West. These bee the chiefest Propositions belonging to the universall Map, wherewith the Terrestriall Globe is covered, and therefore I will now set downe those that belong to the Sunne, which may bee done as well by the one Globe as by the other, and first how to find out the place of the Sunne.

How

Proposition VI.

How to find out by the Globe the place of the Sunne, that is to say, the degree and minute of that Signe wherein the Sunne is every day throughout the yeere.

Although the surest way be to find it out by the Ephemerides, which sheweth the very minute, yet without having respect to the minute, you may find it out by the Globe thus: Seeke out the day of the month upon the Horizon, and that will point you to the degree of the Signe wherein the Sun is that day: As for example, the 6 day of the May pointeth right to the 25 degree of Taurus, the Globe standing levell, and your Rule being rightly laid upon the Horizon: but during the leape yeere you must adde one degree more then the Horizon sheweth, every day from the beginning of the leape yeere throughout all that yeere.

Proposition VII.

How to rectifie the Index of the houre-wheele for every severall day throughout the yeere.

Having placed the Globe at your Latitude, and also found out the degree of the Sunne as is before taught, bring that degree of the Sunne to the brazen Meridian, and there staying it with the one hand, turne with your other hand the Index of the houre-wheele to the highest part of the said wheele marked with the number of 12. setting the point of the Index just with the streke of the wheele made to shew the Houre of 12 of noone tide, and that will serve your turne for all that day, and thus must you do every day in which you have to use the helpe of the said houre-wheele for any purpose.

Proposition. VIII.

How to know every day at what houre the Sunne riſeth or ſetteth.

HAving ſet the Globe at your Latitude, and rectified the Inder of the houre-wheele by the ſeventh Propoſition, turne the Globe to the Eaſt, ſo as the degree of the Sunne may touch the Horizon, and then the Inder of the houre-wheele will ſhew you at what houre the Sunne riſeth. Againe, if you bring the ſaid degree of the Sun unto the Weſt part of the Horizon, the Inder of the houre-wheele will ſhew you at what houre he goeth downe. As for example, Anno 1590, the third of June, the Sunne being in the 21 degree, 33 of Gemini. I bring the point to the very edge of the Horizon on the Eaſt part thereof, and there ſtaying it, the Inder of the houre-wheele ſheweth that the Sunne riſeth 8' before foure of the clocke in the morning: and the ſaid point of the Ecliptique being turned to the Weſt part of the Horizon, the Inder ſheweth that he ſetteth 8' after eight of the clocke at night.

Proposition. IX.

How to know in what part of the Horizon the Sunne riſeth and ſetteth every day.

SEeke the degree of the Sunne in the Ecliptique line, and turne it to the Eaſt part of the Horizon, then you ſhall ſee whether it riſeth juſt Eaſt or not, and whether it inclineth towards the South, or towards the North, and likewiſe by bringing the ſaid degree to the Weſt part of the Horizon, you ſhall ſee in what part of the ſaid Horizon he goeth downe: As for example, in the laſt Propoſition the

Sunne

Sunne being in the 21 degree, 33', of Gemini, and brought to the East part of the Horizon, I find that the Sunne did rise distant from the East towards the North 38 degrees, 30', of the Horizon, which is three points and somewhat more of the Mariners Compasse from East towards the North, so as the Sunne riseth Northeast and by East, and a little more Northward, and the said place of the Sunne being brought to the West part of the Horizon, I find that he setteth Northwest and by West, and somewhat more Northward.

Proposition X.

How to know the length of every day and night throughout the yeare, as well by helpe of the houre-wheele, as by counting the degrees upon the Horizon.



First you must know when the Sunne riseth and setteth by the eighth Proposition, then looke how many houres the Inder doth go from the Sunne-rising to the Sunne-setting, and that is the length of the day, which number if you take from 24 the night will appeare: as for example, knowing by the eighth Proposition, that the Sunne being in the 21 degree, 33', of Gemini, riseth 8' before 4 in the morning, and goeth downe 8' after 8 of the clocke at night, I find by counting the houres which the Inder of the houre-wheele hath runne, that the length of the day is 16 houres and 16', which you may know also by counting the degrees upon the Horizon from the place of the Sunnes rising, unto the South point of the said Horizon, which you shall find to be 128 degrees, which being doubled maketh 256 degrees, which if you divide by 15, it will make 16 houres and 16' as before.

Proposition XI.

How to know by the Globe how much the Sunne declineth every day throughout the yeere from the Equinoctiall.

HAving found the place of the Sunne, bring the same to the brazen Meridian, and by counting how many degrees are betwixt that place and the Equinoctiall, you shall know what declination the Sunne hath that day: As for example, supposing the Sunne that day you seeke to be in the first degree of Gemini, bring the said degree of the Ecliptique to the brazen Meridian, and you shall find upon the same Meridian the Sun to be declined from the Equinoctiall Northward almost 20 degrees. Againe, supposing the Sun to be in the first degree of Aquarius, if you bring the said degree of the Ecliptique unto the Meridian, you shall find the declination of the Sunne to be almost 20 degrees Southward.

Proposition XII.

How to know by the Globe the Meridian Altitude of the Sunne, that is to say, his heigth at noonetide every day throughout the yeere, and how farre he is then distant from your Zenith.

BRing the place of the Sunne that day you seeke to the brazen Meridian, and staying it there, count upon the said brazen Meridian, how many degrees are contained betwixt the place of the Sun, and the South point of the Horizon, and that is the Meridian Altitude of the Sunne for that day, which if you subtract from 90, the remainder will shew how many degrees he is distant that day at noonetide from your Zenith: as for example, supposing the Sunne to be that day you seeke in the first degree of Taurus, bring that degree of the Ecliptique to the brazen Meridian, and stay it there untill you have counted how

how many degrées of the ſaid Meridian are contained betwixt the place of the Sun and the South point of the Horizon, and you ſhall find the number of degrées to be 50, which is the Meridian Altitude of the Sunne for that day, which 50 degrées being taken out of 90, there remaineth 40, and ſo many degrées the Sunne is that day at noonetide diſtant from your Zenith. The like order is to be obſerved in ſeeking to know the Meridian Altitude of any ſtarre, or any other point in heaven.

Proposition XIII.

How to know the Altitude of the Sunne at any other houre of the day.

HAving rectified the Inder of the houre-whéele by the ſeventh Propoſition, if the houre which you ſéeke be in the forenoone, turne the Globe ſo as the Inder of the houre-whéele may touch that houre of the forenoone, at which you deſire to know the Altitude of the Sunne, and there ſtay the Globe, untill you have brought the Quadrant of Altitude on the Eaſt ſide of the Globe unto the place of the Sunne, ſo ſhall you find upon the ſaid Quadrant the Altitude of the Sunne at that houre. And if you deſire to know the Altitude of the Sunne at any houre in the afternoone, then turne the Globe ſo as the Inder of the houre-whéele may touch the houre of the afternoone, and there ſtay the Globe untill you have brought the Quadrant of Altitude on the Weſt ſide of the Globe unto the place of the Sunne, and the ſaid Quadrant will ſhew you the Altitude of the Sunne at that houre. As for example, I would know how high the Sunne is at eight of the clocke in the morning, the Sunne being in the firſt degrée of Taurus: here having rectified the Inder of the houre-whéele I turne the Globe ſo as the Inder of the houre-whéele may lie upon the eight houre of the forenoone, and there I ſtay the Globe untill I have brought the Quadrant of Altitude on the Eaſt ſide of the Globe unto the place of the Sunne, whereby I find the Altitude of

the Sunne at that houre to be almoſt 28 degrées. Againe, if you will know how high the Sunne is being in the ſame degrée of the Ecliptique at 5 of the clocke in the afternoone, then turne the Inder of the houre-whéele, ſo as it may touch that houre and ſtay it there vntill you haue brought the Quadrant of Altitude on the Weſt ſide of the Globe vnto the place of the Sun, ſo ſhall you find the Altitude of the Sunne to be at that houre 21 degrées.

PROPOSITION XIIII.

How to know the houre of the day by the Globe.

THis is to be done two manner of wayes, the firſt is thus, ſet the Globe in ſome open place whileſt the Sunne ſhineth, and you muſt ſée that it ſtand both levell and alſo right North and South, as is taught in the firſt Propoſition, and that the Inder of the houre-whéele be rectified according to the degrée of the ſigne wherin the Sun is that day by the 7 Propoſition, that done, fit a Néedle in the place of the Sun, and turne the body of the Globe to and fro vntill the Néedle caſt no ſhadow at all, and there ſtaying the Globe, the Inder of the houre-whéele will ſhew you the houre of the day. But if you ſéeke the houre in the forenoone, remember to turne the Eaſt ſide of the Globe towards the Sun, if in the afternoone, then turne the Weſt ſide of the Globe towards the Sun. The ſecond way is thus, hauing rectified the Inder of the houre-whéele, take the Altitude of the Sunne with ſome Quadrant or Aſtrolabe, and hauing marked the ſame Altitude vpon the Quadrant of Altitude, apply it to the degrée of the Sun on the Eaſt ſide of the Globe if it be in the forenoone: but if it be in the afternoone apply the Quadrant of Altitude to the degrée of the Sun on the Weſt ſide of the Globe, and the Inder of the houre-whéele will ſhew you the houre which you ſéek. As for example, the 6 of Iune 1590, the Sun being in the 24 degrée 24 of Gemini, I found by my Aſtrolabe the Altitude of the Sun to be 48 degrées, which I marked vpon the Quadrant of Altitude,

titude, and because I toke the Altitude of the Sun in the forenoone, I brought the Quadrant of Altitude marked with that degree to the place of the Sun on the East side of the Globe, and there staying the Globe, I found that the Index of the houre-wheele did point the 9 houre of the forenoone and somewhat past. The like is to be done to know any houre of the afternoone so as you forget not to apply the Quadrant of Altitude unto the place of the Sun on the West side of the Globe. And by taking the Altitude of any knowne Starre, and working in like manner as before, you shall know the houre of the night as shall be taught hereafter when we come to treat of the Starres.

Proposition XV.

To know how much the unequall houres otherwise called the Planetarie houres do differ from the Artificiall houres throughout the yeere, and how many minutes every unequall houre containeth.

First you must know by the 10 Proposition the length of the day, that is to say, how many houres it is long, and reduce those houres into minutes, and divide the Product by 12, and the Quotient, together with the remainder (if there be any left after the division) will shew you the quantity of the unequall houre of the day, that is to say, how many minutes it containeth. The like is to be done to know the unequall houre of the night, for having the length of the Artificiall night, worke as before, and you shall have your desire. As for example, knowing by the 10 Proposition, the length of the day when the Sunne is in the 21 degree, 33′ of Gemini, to be 16 houres 16′, here by reducing those houres into minutes, and by dividing the Product thereof by 12, you shall find the unequall houre of the day to containe 81 minutes, and $\frac{1}{4}$ of a minute, or 26 seconds, which is more than one whole Artificiall houre of the day by 21 minutes

and

and 20 seconds. Againe, knowing the length of the Artificiall night by the said Proposition to be 7 houres, 44 minutes, if you do reduce the same into minutes, and divide by 12, you shall find thereby the unequall houre of the night to containe no more but 38 minutes, and 40 seconds, which is lesse than the artificiall houre of the day by 21 minutes, and 40 seconds.

PROPOSITION XVI.

How to know every day when the dawning of the day, and the twilight of the night beginneth and endeth, and the time of their continuance.



Having rectified the Inder of the houre-whéele by the seventh Proposition, first find out the opposite point to the degrée of the Sunne, and turne the Globe together with that opposite point, and also together with the Quadrant of Altitude towards the West, so as the opposite point may méete even with the 18 degrée of the Quadrant of Altitude, and staying the Globe there, the Inder of the houre-whéele will shew at what houre the dawning beginneth. As for example, I would know at what houre the dawning of the day beginneth the 19 of Aprill 1590, when as the Sunne is in the 8 degrée of Taurus, the opposite point whereof is the eight degrée of Scorpio, wherefore I turne the Globe together with the said point opposite, and also together with the Quadrant of Altitude towards the West, so as the said point opposite may méete even with the 18 degrée of the Quadrant of Altitude, and there staying the Globe, I find by the Inder of the houre-whéele, that the dawning of the day beginneth at two of the clocke in the morning and 20 minutes after, which dawning alwayes endeth when the Sunne riseth, as in the former example, the Sunne being in the 8 degrée of Taurus doth rise 45 minutes after foure of the clocke in the morning, so as the continuance of the dawning is two houres and 25 minutes,

for

for by taking two houres and 20 minutes out of foure houres and 45 minutes, there remaineth two houres and 25 minutes. Againe, the twilight beginneth when the Sunne goeth downe, which in the former example is at seven of the clocke and 15'. Now to know when the twilight endeth, you must do thus, turne the Globe and the Quadrant of Altitude towards the East, so as the opposite point which is the 8 degree of Scorpio, may meet even with the 18 degree of the said Quadrant, and the Index of the houre-wheele will shew you that the twilight endeth at nine of the clocke and 45' after, so as the continuance of the twilight ist wo houres and 30', for by taking seven houres and 15', out of nine houres and 45', there remaineth two houres and 30'. But you have to understand, that the dawning and twilight is not alwayes to be knowne throughout the yeere by the Globe, for from the 11 day of May to the 10 day of July, you shall find that the opposite point of the Sun will not agree just with 18 degrees of the Quadrant of Altitude: because that no opposite point during all that time will amount to above 16 or 17 degrees of the Quadrant of Altitude at the most, because the Meridian Altitude it selfe of any such opposite point is not above 17 degrees, for during all that time both dawning and twilight had need in this our Latitude to be accounted as night, unlesse you will make no night at all.

Proposition XVII.

How to know the ascention of the Sunne both right and oblique.

HAving set the Globe at your Latitude, bring the degree of the Sunne to the brazen Meridian, and there staying it, marke at what number of degrees the said Meridian cutteth the Equinoctiall, counting that number from the first point of the vernall Equinoctiall point to that Section, and that is the right ascention. As for example, the

Sunne

Sunne being in the firſt degrée of Gemini, and brought to the Meridian, you ſhall find that the Meridian cutteth the Equinoctiall in the 58 degrée thereof, and that is his right aſcention. Now if you would know his oblique aſcention, being in the firſt degrée of Gemini, bring that degrée to the Eaſt part of the Horizon, ſo as it may touch the vpper edge thereof, and ſtaying the Globe there, looke what degrée of the Equinoctiall toucheth the Horizon at that inſtant, which you ſhall find to be the 30 degrée of the Equinoctiall, and that is his oblique aſcention. Theſe are the chiefeſt Propoſitions that belong to the Sunne, and are to be found by either of the Globes, wherefore I will now proceed to thoſe Propoſitions that are to be knowne moſt properly by the Celeſtiall Globe. But firſt I will make a deſcription of the ſaid Celeſtiall Globe, whereby it ſhall plainly appeare, wherein the one Globe is like the other, and wherein the one differeth from the other.

Proposition XVIII.

The eighteene Propoſition, containing the deſcription of the Celeſtiall Globe, and ſhewing wherein it is like or differing from the Terreſtriall Globe.

THe Celeſtiall Globe is like to the Terreſtriall Globe, in that it is round, having both like Arctiques, Poles, Houre-wheele with his Inder, Brazen Meridian, Quadrant of Altitude of Braſſe or Latten with his Square head or Zenith, and a halfe Circle of Braſſe or Latten, called the Semicircle of poſition alſo a ſtanding foot with an Horizon of wood diuided into ſeuen ſeuerall ſpaces, containing in a manner the ſelfe ſame things that are before deſcribed in the Horizon of the Terreſtriall Globe, alſo in the body of the Celeſtial Globe are ſet downe certaine Circles like vnto the Terreſtriall Globe, that is to ſay, the Equinoctiall and the Ecliptique line. Moreouer the foure leſſer Circles, that is to ſay, the two

Tropiques

Tropiques, the Circle Arctique, and the Circle Antarctique. But the Celestiall Globe differeth from the Terrestriall Globe in these fours things following. First the Celestiall Globe hath one thinne Semicircle of Brasse or Latten more than the Terrestriall Globe hath, which Semicircle is divided into two quarters, each quarter containeth 90 degrees, made so at each end as it may be fastned when need is, upon the two Poles of the Zodiaque, to find thereby the Longitude and Latitude of every Starre described in the Globe, and therefore may very well be called the Semicircle of Longitude and Latitude. The second difference is, that whereas the Terrestriall Globe is traced with 12 Meridians, dividing the Equinoctiall into 24 spaces, every space containing 15 degrees. The Celestiall Globe is only traced with 6 Meridians, dividing the Equinoctiall into 12 spaces, every space containing 30 degrees. The third Difference is that the Celestiall Globe hath not these 8 Parallels of Latitude wherewith the Terrestriall is traced. The fourth difference is that whereas the Terrestriall is covered with an universall Mappe, containing the 4 principall divisions of the earth, that is, Europe, Affrica, Asia, and America: the Celestiall Globe is covered with a Mappe wherein are painted all the fixed Starres that were knowne to the ancient Astronomers divided into 48 Images, with which Images, to the intent you might be the better acquainted, and that you might the more readily find out any Starre described in the Globe, I thought good to set downe a particular description of the said 48 Images as followeth.

The

PROPOSITION XIX.

The 19 Proposition containeth a particular description of the 48 Images of the fixed Starrs that are in the Celestiall Globe, together with their sundry names, and also the names of so many Starrs as are named in the Globe, of which 48 Images, 21 are ascribed to the North of the firmament, 12 to the Zodiaque, and 15 to the South part of the firmament.

THis description is divided into two parts, according to the twofold declination of the fixed Starres, that is to say, Northerne and Southerne: for those Starres are said to have North declination, which are situated betwixt the Equinoctiall and the North Pole, and those to have South declination which are situated betwixt the Equinoctiall and the South Pole. And because that six great Circles or Meridians, passing thorow the Poles of the world, do divide the Equinoctiall into twelve equall spaces, every space containing 30 degrees, I will beginne my description at the first point of Aries, which is the Vernall Equinoctiall point, and so proceed towards the right hand round about the Globe, setting downe all such Images, or parts of Images, as are situated towards the North Pole, and are contained in every severall space betwixt two Meridians, and having described all the North part, I will use like order in describing the South part. And you may behold all the Northerne Images by turning the Globe about with your hand, without taking the same out of his bed or seat, the Pole being elevated above the Horizon, 50, or 60 degrees. But to view the Southerne Images, it shall be needfull to take the Globe cleane out of his seat, and to hold it so as the North Pole may stand right up, so shall you see every Southerne Image and Starre at your pleasure. And yet to know how the Starres are situated in heaven, you had need to imagine your selfe to be within the Globe, in the very Center thereof, and not without the the Globe, for otherwise those Starres that are situated in heaven on your right

right hand, if you haue regard to the outside of the Globe, will seeme to be on your left hand.

The Northerne Images contained in the first space intercepted betwixt the first Meridian and the second Meridian.

IN this space you shall first see next unto the Equinoctiall, the following Fish of the signe Pisces together with the Bond, both Southerne and Northerne, called in Latine Linum australe & Septentrionale, also the knot of the Bond, which is called Nodus, Syndesmon, and Hipouraion, which is a faire Star of the third bignesse.

Item the first part of Aries with the two Starres in his right horne, from the former Starre whereof the Astronomers do alwayes make their computation.

Item the whole Image of Andromeda, her head and right arme excepted, in whose girdle is a Starre of the third bignesse called Mirach, and in her left foot a Starre of the third bignesse called Alamac.

Item the Triangle called Triangulus and Deltoton with his foure Starres.

Item the whole Image of Cassiopeia saving her right arme, and the upper part of the backe of her chaire, in whose breast is a Starre of the third bignesse called Shedar.

The Northerne Images contained in the second space.

FIrst the head of the Whale called Cetus, in whose snout is a Starre of the third bignesse called Menkar.

Item all the hinder parts of Aries called in Greeke Chrios, in English the Ramme.

Item the right leg, neck, breast, right eare, and mozell of the Bull, in whose right thigh towards the shoulder point is a Star of the fourth bignesse called Alfon, and in his breast a Star of the third bignesse called Alfo, and in his mozell lying upon his right leg, is another Starre of the third bignesse called Alfon, and in his necke towards the withers are 7 Starres of divers

bignesse.

bigneſſe called by theſe diuers names, that is, Virgilie, Atlantides, Pleiades, and Athoratæ, commonly called the ſeuen Starres.

Item the whole head of Meduſa, called Caput Meduſæ vel Gorgonis, and Ras Algol.

Item the whole Image of Perſeus otherwiſe called Chelybe, his right hand, ſword, and right foot excepted.

The Northerne Images contained in the third ſpace.

FIrſt the left legge of the Bull having two Starres thereon: moreouer in his head, horner, and moſt part of his right eare, on whoſe left eye is the Starre of the firſt bigneſſe, called Oculus Tauri, Palilicium, and Aldebaran, alſo in his face are certaine leſſer Starres called Succulæ and Hyadæ.

Item the vpper part of Orion otherwiſe called Alguze, holding a club in his right hand, and a Lyons ſkin in his left hand, on whoſe right ſhoulder is a Starre of the firſt bigneſſe called Bed Alguze, and on his left ſhoulder a Starre of the ſecond bigneſſe called Bellatrix.

Item the left foot of the former Gemini, containing two Starres of the fourth bigneſſe, whereof the one is called Propous.

Item the whole Image of Auriga, otherwiſe called Erichonius and Henlochos holding a raigne and a whip in his right hand, and having a Goat hanging on his back, which hath two little Goates ſucking her behind, which be two Starres of the ſecond bigneſſe, called by diuers names, as Hedi, Herephoi, and Sadateni, and in the flanke of the Goate is a Starre of the firſt bigneſſe called Hircus, Aix, Aolenic and Alhaioc.

The Northerne Images contained in the fourth ſpace.

FIrſt the whole Image of the little Dog, in whoſe left flanke is a Starre of the firſt bigneſſe called Canis minor, Procion, Algomeiſa, and Alſahere.

Item the whole Image of the two Twinnes called Gemini or Didimoi, the left foot of the former Twinne only excepted, which former Twinne is called Apollo, Caſtor, Anhelar, and the

other

other is called Pollux, and Abrachaleus, in whoſe left eare is a ſtarre of the ſecond bigneſſe called Ras Alguze.

Item the taile and halfe the body of Cancer.

Item the Mozell of the great Beare, whereon is a ſtarre of of the fourth bigneſſe.

The Northerne Images contained in the fift ſpace.

FIrſt the head and neck of Hydrus.

Item the fore-part of Cancer called in Greeke Carchinos, upon whoſe right Clea is a ſtarre of the fourth bigneſſe called Acubene, and betwixt his head and his right Clea is a ſtarre called Preſepe, Phatue, and Meelleph, and on his backe are two ſtarres called Aſelli and Onoi.

Item the fore-part of Leo, againſt whoſe heart is a ſtarre of the firſt bigneſſe, called with theſe names, Cor Leonis, Regulus, Baſileus, and Calbalezet.

Item the fore-part of the great Beare called Vrſa major, Arctos Eliche, and Caliſto.

The Northerne Images contained in the ſixt ſpace.

FIrſt the hinder part of Leo otherwiſe called Alazet in whoſe taile is a ſtarre of the firſt bigneſſe called Cauda Leonis, and Deneb Alezet.

Item the head and ſhoulders of Virgo.

Item the darke ſtarre of Bernices haire.

Item the hinder parts of the great Beare, his taile excepted.

Item the hinder parts of the Dragrons taile, containing two ſtarres of the fourth bigneſſe.

The Northerne Images contained in the ſeventh ſpace.

FIrſt the moſt part of Virgo, who is otherwiſe called Parthenos, Erigone, Preuindemiator, Protigiter, Almucedie, and Alaraph.

Item the left leg, and left arme of Bubulcus, otherwiſe called,

Bootes, Vociferator, Arctophilax and Lanceator, betwixt whoſe legges is a ſtarre of the firſt bigneſſe called Arcturus, Aſimech and Alramech.

Item, Bernices haire, called Cincinnus, Ceſaries, Plochamos, Berenceis crinis, and Trica.

Item the taile of the great Beare containing three ſtarres of the third bigneſſe, wherein that next his rumpe is called Aliot, & that which is in the tip of his taile, is called Benenacz.

Item a part of the Dragons taile containing two ſtarres ſtanding nigh together nigh unto the Circle Arctique.

The Northerne Images contained in the eighth ſpace.

FIrſt the head and necke of the Serpent called Anguis, Serpens, Engchelis and Ophis.

Item the crowne of Ariadna, called Corona gnoſia, Stephanos Ariadnis, and is commonly called Corona Septentrionalis, that is, the Northerne Crowne, in which is a ſtarre of the ſecond bigneſſe called Malfelcare, Alpheta and Muniir.

Item the moſt part of the Image of Bubulcus, having a club in his right hand, in whoſe left ſhoulder is a ſtarre of the fourth bigneſſe called Ceginus, and there is another of the fourth bigneſſe in his club, right againſt his face called Incalurus.

Item the fore part of the little Beare called Vrſa minor, Arctos and Cinoſura.

The Northerne Images contained in the ninth ſpace.

FIrſt the upper part of Serpentarius, otherwiſe called Ophioncos and Alangue, in the Crowne of whoſe head is a ſtar of the third bigneſſe called iras alangue.

Item the whole Image of Hercules with the Lyons skinne hanging on his left arme, otherwiſe Engonaſi, Algethi, Neſſus, and ignotum idolum (his right hand holding the club, and his right legge excepted) in whoſe head is a ſtarre of the third bigneſſe, called Ras Algethi, and this Image lyeth groveling with his heeles towards the North Pole, and his head towards

the

the Equinoctiall, which meeteth almost with the head of Serpentarius.

Item the head of the Dragon called Draco and Aben, in whose head is a starre of the third bignesse called Ras Aben.

Item a part of his taile containing 6 starres.

Item the hinder part of the little Beare, containing 2 stars.

The Northerne Images contained in the tenth space.

FIrst, the upper part of Antinous, having at each elbow a star of the third bignesse.

Item the last end of the Serpents taile, in the tippe whereof is a starre of the fourth bignesse.

Item the whole Image of the Eagle called Aquila, Vultur volans, Aetos and Alcair.

Item the whole Image of the Shaft called Sagitta, Telum and Hoistos.

Item the whole Image of the Harpe called Lira and Alohore, that is to say, Vultur cadens, and Chelis, in the upper part whereof towards the left hand is a faire starre of the second bignesse called Fidicula, Lira, Alangue, Vega, and Brineck.

Item the head, necke, and left wing of the Swanne, called Avis, Cignus, Olor, Hornis, Adigege, and of some Gallina.

Item the necke, body, and fore part of the Dragon containing 11 starres.

Item part of the little Beares taile, containing one starre next to his rumpe of the fourth bignesse.

The Northerne Images contained in the eleventh space.

FIrst, the Crowne of Aquarius his head, containing one star of the fift bignesse.

Item the little horse called Equus and Hippos, whose neck is inclosed with a cloud, and in his head are foure little stars.

Item the head and two fore feet of the winged horse called Pegasus, on whose right nostrell is a starre of the third bignesse called Eniph Alpharaz.

Item the Dolphin called Delphinus, containing ten ſtarres whereof one is of the third bigneſſe.

Item the body, legges, and the right wing of the Swanne, which lyeth on her backe with her belly upward, in whoſe body towards the taile, is a faire ſtarre of the ſecond bigneſſe called Deneb, Adigege, and Arided.

Item the right arme and right legge of Cepheus, on whoſe right ſhoulder is a ſtarre called Alderaimim.

Item part of the little Beares taile containing the middle ſtarre of his taile.

The Northerne Images contained in the twelth ſpace.

FIrſt, the moſt part of the former fiſh of the ſigne Piſcis together with part of her band.

Item the necke, body, and wing, of Pegaſus, otherwiſe called Equus Gorgoneus, and Alpharaz, riſing out of a cloud, in which cloud is the head of Andromeda, having on the right ſide thereof a faire ſtarre of the ſecond bigneſſe, and in the right wing of Pegaſus is a ſtarre of the ſecond bigneſſe called Marcab Alpharaz, and on his right ſhoulder another ſtarre of the ſecond bigneſſe called Scheat Alpharaz.

Item the right arme and hand of Andromeda holding part of her Chaine, in the ring whereof is a ſtarre of the fourth bigneſſe.

Item the right arme of Cepheus.

Item the tip of the little Beares taile, in which is the North ſtarre called Alrucuba of the third bigneſſe.

The names of the Images contained in the Celeſtiall Globe, betwixt the Equinoctiall and the South Pole, together with ſo many ſtarres as are named in that part of the Globe, beginning as I did before in deſcribing the Northerne Images at the Vernall Equinoctiall point, and ſo proceed from ſpace to ſpace contained betwixt every two Meridians towards the right hand.

The

The Southerne Images contained in the first space, beginning at the Vernall Equinoctiall point.

FIrſt, the moſt part of the Whale called Cetus, Piſtrix, and Balena (his head and fore part of his belly excepted) in the mid body whereof towards the backe, is a ſtarre of the fourth bigneſſe called Baten Kaetos, and in the lower part of his tayle is another ſtarre of the third bigneſſe, called Deneb Kaitos.

The Southerne Images contained in the ſecond ſpace.

THe fore-part of the Whales belly and his gilles, containing five ſtarres.

Item the moſt part of the floud Eridanus, called, of ſome Nilus, and in Græke Potamos Eridanos, containing 22 ſtars, whereof one is called Angetenar, which is about the middeſt of the floud nigh unto the Whales belly, and there is in the very end of the floud another ſtarre of the firſt bigneſſe, called Acarnar.

The Southerne Images contained in the third ſpace.

FIrſt the nether part of Orion or Alguze from the middle of his backe down ward, in whoſe girdle are three faire ſtars, whereof the middle ſtarre is of the ſecond bigneſſe called Orion or Alguze.

Item another part of the floud Eridanus which ſeemeth to come from the left foot of Orion, which ſtarre in the left foot is called Algebar, Rigel, Alguze.

Item the whole Image of the Hare, called Lepus and Lagos containing 12 little ſtarres.

Item the reſt of Eridanus containing foure ſtarres, whereof there is one called Beemum of the fift bigneſſe.

The Southerne Images contained in the fourth ſpace.

FIrſt, the whole Image of the great Dog called Canis maior, and Syrios, in whoſe mouth is a ſtarre of the firſt bigneſſe called Aſceher and Alhabor.

Item the forepart of the great ship Argos with her two Dares having a scutchen with foure starres, the greatest whereof being of the third bignesse is called Markeb, and under the upper hatches in the fore part of the ship is a star of the fift bignesse called Alphard, and in the left Dare towards the South Pole, is a faire starre of the first bignesse called Canopus and Suhel.

The Southerne Images contained in the fift space.

FIrst, the mid part of the Serpent called Hydrus and Asuia, in the which is a faire starre of the second bignesse called Alphard.

Item the hinder part, mast, and top of the ship Argos, which seemeth to come out of a cloud, containing divers starres of divers bignesse without name.

The Southerne Images contained in the sixt space.

ITem another part of Hydrus, whereupon standeth the Image of the cuppe or boule called Crater, Vas, and Patera, and also the Crowes head.

Item the hinder part of Centaurus, in every part whereof are divers starres without name.

The Southerne Images contained in the seventh space.

FIrst, the left wing of the signe Virgo and her left hand, holding an eare of wheat, whereon is a starre of the first bignesse, called Spica Virginis, Stachis, Acimon, Alacel, & Azimech.

Item the Crow called Corvus and Corax, his head and necke excepted, in whose left wing is a starre of the fourth bignesse called Algorab.

Item the rest of Hydrus, whereon the Crow standeth, containing three starres without name.

Item the rest of Centaurus or Chiron with his horsselike trimmed with boughes, his right hand and right foot excepted.

The

The Southerne Images contained in the eighth ſpace.

THe whole Image of Libra, the King only excepted.

Item the foꝛe part of Scorpio, whoſe foꝛe cleaes do lie upon the two ballances, that is to ſay, his right clea upon the Noꝛth ballance, and his left clea upon the South ballance, having upon each clea a ſtarre of the ſecond bigneſſe.

Item part of the Serpent called Anguis oꝛ Ophis, having one ſtarre of the fourth bigneſſe.

Item the left hand of Serpentarius, holding part of the Serpent, upon which hand are two ſtarres of the third bigneſſe called Yedd.

Item upon the head of Scorpio are three ſtarres of the third bigneſſe, ſtanding all in a row, and divers others as well upon his backe as upon his left little clea without name.

Item the whole Wolfe called Fera, Lupus, and Therion.

Item the right hand of Centaurus holding the ſaid Wolfe by the belly, in both which are divers ſtars without name.

Item the right foot of Centaurus, in which is a faire ſtar of the firſt bigneſſe, and is called by the name of Centaurus.

The Southerne Images contained in the ninth ſpace.

FIrſt, the nether part of Serpentarius, that is to ſay, from his midde backe downeward, having the Serpent winding betwirt his legges and above his right arme, in both which are divers ſtarres without name.

Item the hinder part of Scorpio, from his midde body to the outermoſt end of his taile, who hath divers names, as Scorpius Nepa, Alatrab, in the midſt of whoſe body is a faire ſtar of the firſt bigneſſe called Cor Scorpionis, Antares, and Chalb Alatrab, and in the tip of his taile are two ſtarres of the third bigneſſe, called Alaſcha and Scomlec Alatrab.

Item the moſt part of the Bow with the head of the ſhaft of Sagittarius and his right foot, in al which parts are divers ſtars without names.

Item the Altar with the flame and smoke called Ara, thuribulum, lar, sacrarium, Thimiaterion.

The Southerne Images contained in the tenth space:

THe lower part of Antinous from the breast downeward kneeling upon an Altar containing 4 starrs without name.

Item the forepart of Capricornus his head.

Item the Image of Sagittarius, otherwise called Crotus and toxeuter (his bow, the end of his arrow, and his right foot excepted) having divers starres without name.

Item the Southerne Crowne, called Corona Australis, and Notios stephanos, and of Aratus, it is called Dinotos Cyclos, that is to say, the Southerne Circle, which Crowne is placed betwixt the two forelegges of Sagittarius, and in the said Crowne are divers starres, amongst which there is one of the second bignesse touching the left knee of Sagittarius, called Corona Australis, who also hath on his left foot another starre of the second bignesse without name.

The Southerne Images contained in the eleventh space.

THe fore part of Aquarius otherwise called Ganimedes, and Hydrochos, holding a handkercher in his left hand, wherein are three starres, and hath divers starres in his body without name.

Item the whole Image of Capricornus, otherwise called Pan-Aigoeeros, and Algedi, the forepart of his head only excepted, in whose tayle is a starre of the fourth bignesse called Deneb Aldegi.

Item the hinderpart of the Southerne fish having divers starres without name.

The Southerne Images contained in the twelth space.

FIrst, Aquarius his right hand holding the Water-pot called Vrna and Chalpe, out of which he poureth the Water downe

downe into the mouth of the Southerne fish, which Water is called Aqua ℞ Hydor, in which are divers starrs without name.

Item the lower belly-part of the former fish of the signe Piscis, wherein are two starres without name.

Item both the thighes and legges of Aquarius, upon the calfe of whose right legge is a star of the third bignesse called Scheat Aquarii, and Crus Aquarii.

Item the head of the Southerne fish called Piscis Meridionalis, and Ichthis notios, in whose mouth is a faire starre of the first bignesse called Fomahant.

But you have to understand that besides the 15 Southerne Images before mentioned, there are lately found out by the Portugales and others that have sailed in the East and West Indies foure other Images towards the South Pole, as the Crosse or Croslet, the South Triangle, Noahs Dove or Pigeon, and another Image made like a Philosopher called Polophilax, all which are set downe in the Celestiall Globe, lately set forth by M. Emery Mullineux at the charges of M. William Sanderson, of whom I lately bought both the Globes, that is, the Terrestriall and Celestiall: and I wish that the Longitude, Latitude, and declination of every star contained in the said foure Images were truly set downe, for Plancius maketh some doubt thereof. Notwithstanding if you be desirous to know the Longitude, Latitude, and declination of the said starres by helpe of the foresaid great Globe, then you must worke as I do shew you hereafter in seeking for any starre contained in Mercator his Globe, so shall you have your desire.

Moreover, to most of the starres described in the Globe are annexed the Characters of some of the 7 Planets, to shew the nature and quality of the stars, and some stars are also marked with some one letter or other, the more readily to find out therby the foresaid Characters. As for example, to Cor Leonis are annexed the Caracters of Iupiter and Venus, and under the said starre is set the letter m. to shew the Characters which are not alwayes set hard by the starre, but sometime a good distance off, for where the Characters are set nigh unto the starre, there needeth no letter, as in the starre called Spica Virginis,

whereunto

wherunto are annexed the Characters of Mars and Venus, without any letter to signifie the same, and where divers starrs be of one selfe quality, they are severally marked with letters of one selfe same shape, as about the starre Spica Virginis, you shall find divers little starres, each one marked with the letter h. signifying their nature to be all one, that is, to participate of Mars and Venus, to whose Characters is also joyned the letter h. signifying that they be of that nature and quality.

The Characters are these here following set over every Planets head.

♄ ♃ ♂ ☉ ♀ ☿ ☽

Saturne. Iupiter. Mars. Sol. Venus. Mercury. Luna.

The nature of every one of the Planets here followeth.

SAturne is cold and dry. Iupiter is temperately hotte and moyst. Mars is extreamly hot and dry. Sol hotte and somewhat dry. Venus is temperatly cold and moyst. Mercury is of changeable nature, and pliant to the nature, be it good or bad, of every other Planet or fired starre whereto it is joyned. Luna is cold and moyst.

Besides the Images and starres both Northerne and Southerne above mentioned, there is also set down in the Celestiall Globe a certaine impression called in Greeke Galaxia, that is to say, the milke white way, the description whereof here followeth.

A briefe description of the milke white way, called in Greeke Galaxia, *and in Latine* Via lactea.

THis way as Gareous writeth, proceedeth from the signe Gemini, and so passeth thorow the legs and loynes of Erichonius, and from thence thorow the right side of Perseus, and then thorow the whole Image almost of Cassiopeia, and from thence thorow the left wing of the Swanne

Swanne called Avis, Gallina, and Cignus, and from thence thorow the Image called in Latine Telum, in English a Dart, shaft, or quarrell, and from thence thorow the flying Eagle called in Latine Vultur volans, and from thence thorow the greatest part of Sigittarius his bow, and from thence thorow the Altar called Ara and Thuribulum, and from thence thorow the legs of Centaurus, and so to the ship called Argos, from whence rising againe, and passing thorow part of the great Dog called Canis major, it returneth againe to Gemini.

Thus having described unto you all the 48 Images, and shewed the names of as many starsas are named in the Globe, and also the milkewhite way, I mind now to proceed to the Propositions belonging to the fixed starres described in the Globe, as followeth.

Proposition XX.

How to find out in Heaven any unknowne Starre described in the Globe two manner of wayes, that is, either by the helpe of some knowne starre, or else by knowing the true houre of the night.

The first and surest way is thus: take with your Quadrant or Astrolabe the Altitude of the known star, marking therewith in what part of the heaven the same is situated, East or West, North or South, and then having set your Globe right North and South, and at the true Latitude of the place where you are, bring the Quadrant of Altitude to the said starre, and therewith turne the Globe untill you see that the said starre hath the like place, and the like Altitude in the Globe that it had in heaven, then keeping the Globe still at that stay, seeke in the Globe the starre that you would find out in the firmament, and marke well in what part of the Globe it is situated, and how it beareth from the knowne starre, eyther East, West, North or South, and bring the

the quarter of Altitude to that ſtarre, that you may know the Altitude thereof by helpe of the ſaid Quadrant, which Altitude once taken, turne your eyes towards that part of the firmament, and having placed the Diopter of your Aſtrolabe at that Altitude, looke what ſtarre in that part of the firmament doth anſwere to ſuch Altitude, and that is the ſtarre which you ſeeke, whoſe name for the moſt part is ſet downe in the Globe. The ſecond way is thus, having learned the true houre of the night by ſome clocke or watch, bring the degree of the Sunne unto the brazen Meridian, and holding it there, ſet the Inder of the houre-wheele juſt at the 12 houre, that done, turne the body of the Globe to or fro untill the Inder of the houre-wheele fall juſt upon the houre which you ſeeke, and keeping the Globe at that ſtay, ſeeke out the unknowne ſtarre in the Globe, and conſider how it beareth from you in the Globe either Eaſt, Weſt, North or South, then bring the Quadrant of Altitude to the ſtar, that you may know thereby what Altitude it hath in the Globe which once found, and having ſet the Diopter of your Aſtrolabe at that Altitude, turne your eyes towards that part of the firmament whereunto the place of the ſtarre found in the Globe directeth you, and that ſtarre which anſwereth to that Altitude is the ſtarre which you ſeeke. But this way is not ſo ſure as the other way firſt taught, unleſſe you know the true houre indeed.

Proposition XXI.

How to know by the Globe the Meridian Altitude which is the higheſt Altitude of any Starre, and alſo how high or low he is at any other time.

HAving ſet the Globe at your Altitude, bring the ſtar to the brazen Meridian, and there ſtaying it, number upon the brazen Meridian the degrees contained betwixt the ſaid ſtarre and the South or North point of the Horizon, according as the ſtarre is ſituated either Northward or Southward, for ſo in the Latitude 52 you

you shall find the Meridian or highest Altitude of the Starre Arcturus or Bubulcus to be 6 degrees. But if you would know his Altitude at any other time, then you must rectifie the Inder of the houre-whéele by the seventh Proposition, and having set the Inder at the houre wherein you séeke, stay the Globe there, untill you have brought the Quadrant of Altitude unto the Starre, and that will shew the Altitude of the Staree at the houre if it be above the Horizon.

Proposition XXII.

How to know by the Globe what Starres are above the Horizon at any time of the day or night.

If Starres according to divers Latitudes, some are alwayes above the Horizon, and some are alwayes under the Horizon, and some do both rise and set. If you would know what Stars be above the Horizon in the day time, then having rectified the Inder of the houre-whéele by the seventh Proposition, take the Altitude of the Sunne with your Astrolabe or Quadrant, and therewith consider whether the Sunne be in the East part, or in the West part of the firmament. Then bring the Quadrant of Altitude on the East or West side of the Globe according as you saw the Sunne at that present to be in the firmament, and make the degrée of Altitude marked in the Quadrant of Altitude, to méet even with the degrée of the Ecliptique line wherein the Sunne is that day, and there staying the Globe, you shall sée all the Starres that bée above the Horizon at that present, as well on the East side, as on the West side of the Globe, and the Inder will shew you at what houre you tooke the foresaid Altitude. But if it be in the night season, and that the Starres do appeare, take with your Astrolabe the Altitude of some knowne Starre, and by doing as is before taught, you shall have your desire. But you must not forget first of all to rectifie the Inder of the houre-whéele by the seventh Proposition.

How

Proposition XXIII.

How to know by the Globe at what time any Star riseth above the Horizon, mounteth to the highest, and setteth: and with what degree of the Ecliptique he riseth, mounteth, and setteth: and also in what part of the Horizon hee riseth and setteth.

HAving rectified the Inder of the houre-wheele by the seventh Proposition, bring the starre to the East part of the Horizon, so as it may touch the edge thereof, and the Inder of the houre-wheele will shew at what houre he riseth, and by looking at that instant to the Ecliptique line you shall see what degree of the Ecliptique ariseth then with him. That done, bring the said star to the brazen Meridian, and the Inder of the houre-wheele wil shew at what houre he is at the highest: and there staying the Globe, marke what degree of the Ecliptique line doth fall right under the brazen meridian at that instant, for that degree is said to accompany him when he is at his highest. Then bring the said starre to the West part of the Horizon, and you shall find by the Inder of the houre-wheele at what houre he setteth, and what degree of the Ecliptique doth accompany him at his setting. As for example, I would know the fifteenth day of June 1590, the Sunne being in the fourth degree of Cancer, when Arcturus otherwise called Bubulcus and Lanceator doth rise, mounteth to the highest, and setteth: here having rectified the Inder of the houre-wheele by the seventh Proposition, I bring the said starre to the East part, and very edge of the Horizon, and I find that he riseth a little before 12 of the clocke at noone, and that the 28 degree, and 30 of Virgo riseth with him, and by looking amongst the winds upon the Horizon right against the place of his rising, I find that he riseth Northeast and by East. Secondly by bringing the said star to the brazen Meridian, the Inder of the houre-wheele sheweth that he is at his highest halfe an houre after seven of the clocke at night, and is then plaine South, and that the 29 of Libra doth

doth then accompany him. Thirdly, by bringing the said starre to the West part of the Horizon, the Inder of the houre-whéele sheweth that he setteth or goeth downe a quarter of an houre before foure in the morning, and that the fourth degrée of Capricornus doth accompany him at his setting: and by looking there upon the Horizon, I find amongst the winds that the said starre setteth Northwest and by West.

PROPOSITION XXIV.

How to know in what part of the firmament any Starre is, and how many degrees it is distant from the Meridian at any houre: and being right under the Meridian, to know how farre it is distant from your Zenith.

HAving rectified the Inder of the houre-whéele by the seventh Proposition, turne the Globe untill the Inder touch the houre wherein you séeke. And staying the Globe there, bring the Quadrant of Altitude to the starre be it on the East or West side of the Globe, and the nether end of the said Quadrant will shew upon the Horizon among the winds, in what part of the firmament the starre is: now if you would know how farre that starre is distant from the Meridian, do thus: Looke what degrée of the Equator is at that instant under the Meridian, & there make a mark, and then turne the Globe untill you have brought the said starre under the brazen Meridian, & marke what degrée of the Equinoctiall the said Meridian cutteth at that instant: that done, count the degrées contained betwixt the two markes upon the Equinoctiall, for so many degrées is the starre distant at that time from the Meridian either towards the East or West, and by allowing 15 degrées to an houre, & 4 to a degrée, you shall know in what time the said starre hath to approach to the Meridian, or how much he is past the Meridian, and having brought the said starre right under the Meridian, you shall know how farre it is distant from your Zenith, by counting the degrées that are contained in the Meridian betwixt

betwixt the ſaid ſtarre and your Zenith. As for example, the firſt of October 1591 (the Sunne being then in the 22 of Libra) I find the ſtarre Cor Leonis at three of the clocke in the afternoone to be Weſt Northweſt, and there ſtaying the Globe, I ſee that the Meridian cutteth the Equinoctiall at the 246 degree, whereas I make a marke: and that done, I bring the ſtarre Cor Leonis to the ſaid Meridian, at which inſtant the Meridian cutteth the Equinoctiall in the 146 degree, which being taken out of 246, there remaineth 100 degrees, which is his diſtance from the Meridian, which being divided by 15, I find in the Quotient 6 houres and 40′, for ſo much he is paſt the Meridian towards the Weſt, and by bringing the foreſaid ſtar to the Meridian I find him to be diſtant from our Zenith 39 degrees, and 30 minutes.

Proposition. XXV.

How to find the houre of the night by the Globe.

Having ſet the Globe at your Latitude, rectifie the Inder of the houre-wheele by the eleventh Propoſition, then having taken the Altitude of ſome ſtarre that you know, and is in the Globe, with your Aſtrolabe or Quadrant, bring the Quadrant of Altitude unto the ſtar, be it in the Eaſt or Weſt, according as you found the ſtar to be in the firmament, not leaving to turne the Globe untill you have made the ſtar to have the like Altitude in the Globe upon the Quadrant of Altitude, & alſo the like ſituation that you found it to have in the firmament by your Aſtrolabe or Quadrant, and ſtaying the Globe there, the Inder of the houre-wheele will ſhew the houre: As for example, in the yeare 1590, the firſt of January the Sunne being in the 22 of Aquarius, I having with my Aſtrolabe found that the ſtar called Canis maior, that is to ſay the greater dogge, was elevated above the Horizon in the Eaſt part of the firmament 20 degrees, I brought the

Quadrant

quadrant of Altitude to the East side of the Globe, not leaving to turne the Globe untill I had made the starre meet even with the 20 degree of the quadrant of Altitude, and there staying the Globe, I found by the Index of the houre-wheele, that it was 8 of the clocke at night, and a quarter past.

Proposition XXVI.

How to know the Verticall starres in every latitude.

THe Globe and the brazen Zenith being set according to the latitude of the place where you are, turne the Globe from East to West, and as many starres as passe right under your Zenith are said to be verticall, as in the latitude 52 you shall see the taile of the great Beare, the head of Perseus, and diuers others to passe thorow your Zenith in turning the Globe from East to West.

Proposition XXVII.

How to know the true place of any Starre, that is to say, in what signe, and in what degree thereof any starre is.

HAuing fastned the Semi-circle of longitude and latitude upon the two Poles of the Zodiaque: the North Pole whereof is in the Circle Arctique not farre from the right claw of the Dragon, and the South Pole thereof is in the Circle Antarctique right opposite to the other, then bring the said Semicircle to the starre whose place you seeke, and marke therewith what point of the Ecliptique the said Semi-circle cutteth, and that is the place of the Starre. As for example, by bringing the said Semi-circle to the starre called Hircus, that is to say, the Goat, I finde it to be in the 15 degree 30 minutes of Gemini, and that is his place.

Proposition XXVIII.

How to finde the longitude of any ſtarre by the Globe.

I Have told you in my Spheare, that the longitude of any ſtarre is that arch or portion of the Ecliptique line, which is contained betwixt the firſt point of Aries, and that Circle which paſſeth thorow the Poles of the Zodiaque and alſo thorow the body of the ſtarre, which Circle, the Semi-circle of longitude and latitude here repreſenteth: and by making the ſaid Semi-circle to paſſe thorow the ſtarre called Hircus before mentioned, I finde that the number of degrées of the Ecliptique, contained betwixt the ſaid Circle, and the firſt point of Aries, to the 75 degrées and 30′, which is the longitude of the ſaid ſtarre, and thereby maketh his place to be in the 15 degrée 30′ of Gemini, as before is ſet downe in the laſt Propoſition.

Proposition XXIX.

How to finde out the latitude of any ſtarre.

I Told you alſo in my Spheare, that the latitude is none other thing, but the diſtance of any ſtar from the Ecliptique line either towards the North or South Pole of the Zodiaque, which diſtance the Semi-circle of longitude and latitude made to paſſe thorow the body of the ſtar, and cutting the Ecliptique line, doth always ſhew, as in the former example, in making the foreſaid Semi-circle to paſſe thorow the foreſaid ſtar called Hircus, I finde by counting the degrées of the ſaid Semi-circle contained betwixt the Ecliptique line and the body of the ſtarre, that the latitude of that ſtarre is 22 degrées and 30 minutes towards the North: likewiſe by bringing the ſaid Semi-circle to the ſtarre which

is

is in the right ſhoulder of Orion called bed Alguze, I finde his latitude to be 17 degrees towards the South.

Proposition XXX.

How to finde out by the Globe, the declination of any ſtar.

THe declination is none other thing but the diſtance of any ſtar from the Equinoctiall either towards the North Pole or South Pole of the world, which is to be found thus: Firſt having brought the ſtar right under the brazen Meridian, and there ſtaying the Globe, count the degrees of the ſaid Meridian contained betwixt the ſaid ſtarre and the Equinoctiall point or ſtreke of the ſaid Meridian and that ſhall be the declination of the ſtarre: As for example, bring the ſtar Hircus unto the Meridian, and you ſhall finde the declination thereof to be 45 degrees towards the North Pole of the world, and that the ſtarre which is in the foot of the Hare called Lepus, hath of South declination 23 degrees.

Proposition XXXI.

How to know the magnitude or greatneſſe of any ſtarre, and his nature and quality by the Globe, and alſo the right aſcention of the Arch of the Ecliptique, which accompanieth the right aſcention of any ſtarre.

MErcator deſcribeth the ſix magnitudes of the ſtars by making the ſix figures or ſhapes of the ſtars placed not farre from the head of the great Beare, whereof the firſt and greateſt hath 16 points or beames, the ſecond eight, the third ſix, the fourth five, the fift ſix, which inward by

that account would be but foure: and the firſt hath five, which would have but three: but in mine opinion it had bin better to have made the firſt magnitude with ten points, the ſecond with nine, the third with eight, the fourth with ſeven, the fift with ſix, and the firſt with five: ſo ſhould the the magnitude of every ſtar deſcribed in the Globe have bine the more eaſily known. But to the intent that you might exerciſe your ſelfe in finding out by the Globe, the place, longitude, latitude and declination of any ſtarre that is deſcribed in the Globe, I have thought good to adde hereunto the Table of Garceus, ſhewing not only the longitude, latitude, and declination of the moſt notable ſtarres that are both Northward and Southward, but alſo the right aſcention, magnitude or bigneſſe, the quality and nature of every ſuch ſtarre, and alſo the Arch of the Ecliptique line, which accompanieth the right aſcention of every ſtarre: which Table though by the ſaid Garceus it was calculated out of the Aſtronomicall Tables for the yeare of our Lord 1564, and not by the Globe, yet for your better exerciſe in matters of the Globe, I thought good to ſet downe ſuch longitude, latitude, declination, magnitude, and right aſcention, and all other things contained in the ſaid Table, according as they are to be found out by the Celeſtiall Globe of Mercator, and not calculated by any of the Aſtronomicall Tables.

Though the longitudes and declinations of the fixed ſtarres ſet downe in this Table to ſerve Mercator his Globe, do not altogether agree with the great Celeſtiall Globe, lately ſet forth by Maſter Sanderſon, and by Maſter Molineux, by reaſon that the longitudes and declinations of the ſaid ſtarres are more lately calculated, that is to ſay, for the yeare of our Lord 1592, yet it will ſerve to ſhew you the way how to exerciſe your ſelfe in the ſaid Globe, and thereby you may correct this Table, and make it to agree in all points with the new great Globe, whereby you ſhall reape more pleaſure than griefe or paine. For I had this Table (as I have ſaid before) out of Garceus, and did here ſet it down more for your exerciſe, and to acquaint you with the fixed ſtarres that are deſcribed in the Celeſtiall Globe, than for any other purpoſe.

The uſe of the Table next enſuing.

THis Table is diuided into eight Collums. The firſt whereof on the left hand containeth the names of the ſtars. The ſecond the degrees and minutes of longitude, together with the Characters of the 12 ſignes. The third the degrees and minutes of latitude both Northerne and Southerne, the North latitude being marked with the letter N, and the South latitude with the letter S. The fourth containeth the degrees and minutes of declination both Northerne and Southerne, marked with the letters N and S, as before. The fift sheweth the magnitude or greatneſſe of the ſtarre, whether it be of the firſt, ſecond, or third bigneſſe, &c. The ſixt containeth the degrees and minutes of the right aſcention of the foreſaid fixed ſtarre. The ſeuenth containeth the Characters of the Planets, ſignifying the nature and quality of the ſtarres. The eighth containeth the degrees and minutes of the right aſcention of the Ecliptique line and the ſignes of the Zodiaque.

Here followeth the Table.

The names of the starres.	The Longitude & place.		The signes.	The Latitude		North and South.
The first starre of the Rammes horne	27	40	♈	7	40	North.
The right shoulder of Cepheus.	8	0	♈	69	0	North.
The left fist of Andromeda	12	30	♈	53	30	South.
The shoulder of Andromeda.	16	20	♈	24	30	North.
The girdle of Andromeda	24	50	♈	26	30	North.
The right side of Perseus.	25	0	♉	30	0	North.
The head of Algol or Medusa	20	40	♉	23	0	North.
The south starre of Pleiades	23	29	♉	4	20	North.
The North starre of Pleiades	23	10	♉	5	0	North.
The Ruth ☿	2	50	♊	5	0	South.
The right shoulder of Orion	23	0	♊	17	0	South.
The left shoulder of Orion	12	0	♊	17	0	South.
The right shoulder of Auriga.	24	0	♊	20	0	North.
The Goat or Hircus.	16	0	♊	22	30	North.
The former of the Kids	13	0	♊	18	0	North.
The later of the Kids	13	50	♊	18	0	North.
The left foot of Orion.	10	10	♊	31	30	South.
The taile of the little Beare	21	10	♊	66	0	North.
The middle star of Orions girdle	18	0	♋	24	30	South.
Canopus in the ship Argo.	8	30	♋	75	0	South.
The great Dogge.	9	0	♋	39	10	South.
The little Dogge.	20	30	♋	16	0	South.
The former head of Gemini.	14	20	♋	9	40	North.
The following head of Gemini.	17	40	♋	6	30	North.
The North Asellus.	1	30	♌	3	0	North.
The South Asellus in Cancer.	2	20	♌	0	10	South.
Tracsep. Marg. in Cancer	1	20	♌	0	40	North.
The shoulder of the great Beare.	11	40	♌	49	0	North.
The bright starre of Hidrus.	21	0	♌	20	30	South.
The Lyons heart.	23	30	♌	0	10	North.
The Lyons neck.	23	10	♌	8	30	North.
The Lyons tayle.	15	30	♍	12	0	North.
The middle starre of the great Beares tayle.	9	50	♍	56	0	North.
The right wing of Virgo.	3	10	♎	15	10	North.

Declination	Nor. & South.	Magnitude or greatneſſe.	The right aſcention. Degr.	Min.	The nature of the Stars ſhewed by the characters of the Planets	The right aſcention of the arch Ecliptique accompanying the ſtar.		The characters of the Signes.
17 20	Nor.	3	23	0	♂ ♄	25	0	♈
61 0	Nor.	3	317	15	♄ ♃	15	0	♎
41 0	Sou.	1	43	30	♃ ♀	15	50	♌
28 26	Nor.	3	5	0	♀	5	0	♈
33 0	Nor.	3	12	10	♀	13	0	♈
48 0	Nor.	2	43	0	♄ ♃	15	29	♉
39 30	Nor.	2	40	20	♄ ♃	13	0	♉
22 0	Nor.	5	50	18	♂ ☽	23	10	♉
23 10	Nor.	5	50	0	♂ ☽	22	20	♉
15 30	Nor.	1	63	9	♂	4	20	♊
6 20	Nor.	1	83	20	♂ ☿	23	50	♊
4 40	Nor.	2	72	0	♂ ☿	13	0	♊
43 0	Nor.	2	82	32	♂ ☿	22	50	♊
45 0	Nor.	1	71	30	♂ ☿	13	0	♊
40 0	Nor.	4	68	50	♂ ☿	10	28	♊
39 40	Nor.	4	69	0	♂ ☿	11	0	♊
9 0	Sou.	1	73	0	♃ ♄	14	20	♊
86 0	Nor.	2	4	30	♄ ♀	4	30	♈
1 50	Sou.	2	79	45	♃ ♄	20	20	♊
52 0	Sou.	1	94	24	♄ ♃	3	30	♋
16 0	Sou.	1	97	0	♂ ♃	6	30	♋
6 10	Nor.	1	109	30	♂	18	0	♋
32 0	Nor.	2	106	47	♀	15	28	♋
28 30	Nor.	2	110	5	♂	18	20	♋
22 30	Nor.	4	124	0	♂ ☉	1	40	♌
19 20	Nor.	4	124	50	♂ ☽	2	0	♌
20 0	Nor.	neb.	124	0	♂ ☽	1	30	♌
62 30	Nor.	2	161	0	♂	9	30	♍
5 0	Sou.	2	137	0	♄ ♂	14	30	♌
13 30	Nor.	1	145	53	♃ ♂	23	30	♌
21 40	Nor.	2	148	40	♄	26	0	♌
16 20	Nor.	1	171	10	♄ ♀	20	30	♍
56 55	Nor.	2	196	0	♂	17	0	♎
12 30	Nor.	2	189	0	♄ ☿	9	40	♎

The names of the starres.	The Longitude & place.	The Signes.	The Latitude	North and South.
The left shoulder of Bubulcus.	10 0	♎	49 30	North.
The Ravens bill.	6 20	♎	21 40	South.
Arcturus the great star betwixt Bubulcus his legs.	18 0	♎	32 30	North.
Spica virginis.	17 40	♎	2 0	South.
The middle starre in the front of Scorpio.	26 40	♏	1 30	South.
The South ballance of Libra.	9 0	♏	0 40	North.
The North starre of the ballance Libra.	13 10	♏	9 0	North.
The left hand of Serpentarius.	72 0	♏	17 0	North.
The bright star of Ariadnes crowne.	5 30	♏	44 30	North.
The heart of the Scorpion.	3 30	♐	3 30	South.
The head of Hercules.	8 40	♐	37 30	North.
The head of Serpentarius.	15 30	♐	36 0	South.
The head of the Dragon.	20 20	♐	76 0	North.
The bright starre of Lyra.	9 0	♑	62 0	North.
The Eagle, alias Vultur volans.	24 50	♑	29 20	North.
The first starre of the taile of Capricornus.	16 0	♒	2 0	South.
The following star thereof	17 10	♒	2 0	South.
The taile of the Dolphin.	8 10	♒	29 30	North.
The Fomahant.	28 0	♒	23 0	South.
The point of the dart.	1 10	♒	29 30	North.
The taile of the Swanne.	0 20	♓	60 0	North.
The right thigh of Pegasus.	22 50	♓	31 0	North.
The taile of the Whale.	27 0	♓	20 20	South.

PROPOSITION XXXII.

How to finde out the right and oblique ascention of any starre, and also the ascentionall difference.

THe right ascention of any star is an arch or portion of the Equator, to be counted from the first point of Aries according the succession of the Signes, with which portion in a right Spheare any star both riseth, mounteth to the Meridian, & setteth: and in an oblique Spheare it is a portion of the Equator, wherewith the starre is mounted to the Meridian:

Declination	Nor. & South.	Magnitude or greatneſſe.	The right aſcention. Degr.	Min.	The nature of the Stars ſhewed by the characters of the Planets.	The right aſcention of the arch Ecliptique accompanying the ſtar.		The characters of the Signes.
40 0	Nor.	3	213	0	♄ ☿	5	0	♏
22 30	Sou.	3	176	43	♄	26	20	♍
22 0	Nor.	1	209	0	♅ ♂	1	0	♏
10 0	Sou.	1	195	10	♂ ♀	16	30	♎
21 0	Sou.	3	234	0	♀ ♄	26	30	♏
14 0	Sou.	2	217	0	♄ ♂	9	20	♏
8 0	Sou.	2	223	10	♅ ☿	15	46	♏
3 30	Sou.	3	238	30	♄ ♀	03	0	♏
28 0	Nor.	2	229	0	♀ ☿	21	20	♏
25 0	Sou.	2	241	0	♅ ♂	3	0	♐
15 0	Nor.	3	252	35	☿	14	0	♐
12 50	Nor.	2	258	30	♂ ☿	16	10	♐
52 0	Nor.	3	266	10	♄ ♂	26	30	♐
38 20	Nor.	1	275	20	♀ ☿	5	0	♑
7 30	Nor.	2	210	40	♄ ♂	20	4	♑
18 0	Sou.	3	319	0	♅ ♄	17	0	♒
17 30	Sou.	3	320	10	♅ ♄	18	0	♒
10 0	Nor.	3	304	0	♄ ♂	1	10	♒
32 10	Sou.	1	339	0	♀ ☿	7	0	♓
18 10	Nor.	4	295	0	♂ ♀	23	8	♑
43 30	Nor.	2	307	10	♂ ☿	5	0	♒
25 0	Nor.	2	341	0	♅ ♂	9	30	♓
19 50	Sou.	3	5	35	♄	6	0	♈

Meridian: as for example, in a right Spheare the ſtar called Cor Leonis, that is to ſay, the heart of the Lyon, riſeth, mounteth, and ſetteth with the 145 degrees 30′ of the Equinoctiall. But the right aſcention of the ſaid ſtar in an oblique Spheare is to be found only by bringing the ſaid ſtarre to the Meridian, and you ſhall finde it to be all one with the right aſcention in a right Spheare, for by bringing the ſtar called Cor Leonis to the Meridian in an oblique Spheare, you ſhall finde the right aſcention thereof to be all one with that which it had in a right Spheare, that is, 145 degrees 30′ of the Equinoctiall. But if you would know the oblique aſcention of any ſtarre, then ha-

ſtings

bing set the Globe at your Latitude, bring the starre to the East part of the Horizon, and marke what degrée of the Equinoctial riseth therwith, and that is the oblique ascention: As for example, the Globe standing at the Latitude 52, bring the star Cor Leonis to the East part of the Horizon, & by staying ỹ Globe there you shall find the 127 degrée of the Equinoctial to rise with that star. Now if you would know the ascentionall difference, that is to say, the difference betwirt the right & oblique ascention you have no more to do but to subtract the lesser out of the greater, and the remainder shall be the ascentionall difference, as in the former example, take 127 degrées out of 145 degrées and 30', and there shall remaine 18 degrées 30', and that is the ascentionall difference: by help wherof you may know the increase and decrease of the artificiall day and night throughout the yére in any Latitude, if you observe that order which I have already set downe in the first part of my Spheare, the 50 Chapter.

Proposition XXXIII.

To know in what quantitie of time any whole Signe or any other Arch of the Ecliptique doth rise or set.

HAving set the Globe at your Latitude, and rectified the Inder of the houre-whéle by the seventh Proposition, bring the beginning of any Arch or Signe to the East part of the Horizon: and marke what degrée of the Equinoctial riseth therewith, that done, bring the end of the said Signe or Arch to the East part of the Horizon, and marke there also what degrée of the Equinoctial toucheth the Horizon, & staying the Globe there, look how many houres or parts of houres the Inder of the houre-whéle hath run betwirt the beginning and ending of the said Signe or Arch, and so you shall know the quantitie of that time. You may know it also by the number of degrées of the Equinoctiall contained betwirt the beginning and ending of the said Signe or Arch, by allowing 15 degrées to an houre, & 4' to a degrée. As for example, supposing the Sun to be in the first degrée of Taurus, you shall find by working according to the Rule before set down, that the whole

whole ſigne of Taurus doth ſpend in riſing one houre 8′. Now if you will know how much time he ſpendeth in deſcending, bring the firſt degrée of Taurus to the Weſt part of the Horizon, marking what degrée of the Equinoctiall toucheth the Horizon at that inſtant, and alſo to what houre the Inder pointeth, then turne the Globe ſtill Weſtward untill the laſt degrée of Taurus méeteth even with the edge of the Horizon, and then mark againe as well the degrées of the Equinoctiall that toucheth the Horizon, as alſo to what houre the Inder pointeth: and you ſhall finde the number of degrées of the Equinoctial to be 42 degrées, which maketh two houres, 48 minutes, which is anſwerable to the houre of the houre-whéele: and ſo much time the whole ſigne of Taurus ſpendeth in his deſcention or going downe.

Proposition XXXIIII.

How to know by the Globe what ſtarres do riſe or ſet every day Coſmically, Acronically, or Helically.

AS for the threefold Poeticall riſing and ſetting of ſtars, you ſhal finde them plainly defined in the firſt part of my Spheare, Chap. 35; but to finde out the ſame by the Globe, you muſt do thus: Firſt having ſet the Globe at your latitude, and ſought out the place of the Sunne for that day, bring the degrée of the Sun to the Eaſt part of the Horizon, and ſtay the Globe there, that you may ſée what ſtars do riſe a little before the Sun, and which riſe together with the Sun. For thoſe that riſe a little before the Sun, are ſaid to riſe Helically, and thoſe that riſe together with the Sunne are ſaid to riſe Coſmically, and thoſe ſtarres that are in the very Weſt part of the Horizon at the riſing of the Sun, are ſaid to ſet Coſmically. Againe thoſe ſtarres that riſe immediatly after Sun, do ſet Helically. That done, turne the degrée of the Sunne unto the Weſt part of the Horizon, & ſtaying the Globe there, marke what ſtarres are ready to go downe with him, for thoſe are ſaid to ſet Acronically, and ſtaying the Globe ſtill there in the Weſt, marke

marke what ſtarres at that preſent do riſe in the Eaſt part of the Horizon, for thoſe are ſaid to riſe Acronically.

Proposition XXXV.

To know in what time of the yeere any ſtarre riſeth or ſetteth either Coſmically, or Acronically.

HEre having ſet the Globe at your latitude, and knowing the degree of the Sun, bring the ſtar to the Eaſt part of the Horizon, and therwith conſider what degree of the Ecliptique the Horizon cutteth at that preſent: that done, finde out the ſelfe ſame degree upon the Horizon in the narrow ſpace of degrees next unto the body of the Globe, and right againſt that degree you ſhall find in what day and month that ſtarre doth riſe Coſmically. As for example, I would know at what time of the yeere Cor Leonis riſeth Coſmically in the latitude 52. I bring the ſtarre Cor Leonis to the Eaſt part of the Horizon, and I finde that the Horizon cutteth the Ecliptique in the 23 degree 30′ of Leo, which degree being found againe upon the Horizon, pointeth to the firſt day of Auguſt, ſo as I conclude that Cor Leonis doth riſe that preſent day Coſmically, for then both hee and the Sunne are in a manner in one ſelfe degree of the Ecliptique: now to know the Coſmicall ſetting of the ſaid ſtarre, turne the ſame ſtarre to the Weſt part of the Horizon, and marke what degree of the Ecliptique doth then riſe in the Eaſt, and you ſhall finde the ſame to bee the 23 degree of Aquarius, which degree being found againe upon the Horizon in the narrow ſpace of degrees next to the body of the Globe, containing the degrees of the Zodiaque, will point to the 31 day of January, at which time the Sunne is oppoſite to the ſaid ſtarre, and therefore it is ſaid to go downe Coſmically, becauſe it goeth downe when the Sunne riſeth. Now to know the Acronical riſing of any ſtar at any time, bring the ſtarre to the Eaſt part of the Horizon, and marke therewith what degree of the Ecliptique goeth downe in the Weſt at that inſtant, for the Sun being in that degree is oppoſite to the ſtar: As for example, by bringing the ſtar Cor Leonis to the Eaſt part

of

of the Horizon, you shall find that the 23 degree of Aquarius goeth down at that instant, which degree being found againe upon the Horizon, will shew the day and month when the star riseth Acronically, and so you shall finde the star Cor Leonis to rise Acronically the 31 day of January. Contrariwise, if you would know when the said star setteth Acronically, bring the said star Cor Leonis to the West part of the Horizon, and therewith marke what degree of the Ecliptique then setteth in the West, which degree being found againe upon the Horizon, will shew that the said star setteth Acronically the 6 of August

Proposition XXXVI.

Of the Horoscope and the rest of the twelve houses.

This word Horoscope doth not only signifie the degree of the Ecliptique, otherwise called the ascendent, which riseth above the Horizon in the beginning of any thing that is to be sought or known, but also sometimes the whole figure of heaven containing the 12 houses, and doth shew the very secrets of nature, so that there is nothing that chanceth to the inferiour bodies, but some cause thereof doth appeare by meane of the Horoscope in the heaven, and therefore the Astrologians have divided the whole heaven into 12 houses, which are numbered from the Horoscope, which is the East Angle, & so forth according to the succession of the signes, of which 12 houses the foure principall are foure points of the Zodiaque, whereof two do fall upon the Horizon, and the other two upon the Meridian, and are called principall points, Poles, or Angles, that is, the beginning of the first house, of the fourth house, of the seventh house, and of the tenth house, and those that do follow next any of these principall Angles, are called succeeding houses, in Latine Succedentes, as the second, the fifth, the eight, and eleventh house. And those that go next before any of the foure principall Angles, are called falling houses, in Latine Cadentes, as the twelfth, the third, the sixth, and the ninth: and such houses as have no familiarity with the Horoscope or

Ascendent,

aſcendent, as the ſecond, the ſixth, the eighth, and the eleventh houſes are ſaid to be ſlow and deject, all which things this Table here following both ſhews, containing the number and names of the houſes, and alſo their ſignifications.

The 12 houſes.	*The names of the houſes.*		*The ſignifications of the houſes.*
1	Angle	Eaſt	life
2	ſucceeding	the lower gate	goine
3	falling	the Goddeſſe	brethren
4	Angle	the bottome of Heaven	parents
5	ſucceeding	good fortune	children
6	falling	evill fortune	health
7	Angle	the Weſt	wife
8	ſucceeding	the higher gate	death
9	falling	God	religion
10	Angle	the middle of Heaven	kingdome
11	ſucceeding	the good ſpirit	benefactor
12	falling	the evill ſpirit	priſon



Proposition XXXVII.

How to finde out the Horoſcope or Aſcendent at any time of the day or night by the Globe, and thereby to know the foure principall Angles of Heaven.

FIrſt having ſet the Globe at your latitude and rectified the Inder of the houre-wheele according to the degree of the ſigne wherein the Sunne is that day you ſeeke by the 7 Propoſition, if it be in the day time, take with your Aſtrolabe or Quadrant the altitude of the Sunne. But if it be in the night, take the altitude of ſome knowne ſtarre, that thereby you may know the houre of the day or night in which you ſeeke the aſcendent. But if it happen that neither Sunne nor ſtar is to be ſeene that day or night, then learne by ſome true Clock or Watch what houre it is, and having ſet the Inder of the houre-wheele at that houre, ſtay the Globe there, and therewith marke what degree of the Ecliptique riſeth in the Eaſt part of the Globe above the Horizon at that inſtant, and that degree is the Horoſcope or aſcendent for that houre. As for example, you would find out the aſcendent the 16 of June 1590, at 8 of the clock in the forenoone, at which day the Sunne is in the 4 degree of Cancer: here having firſt ſet the Inder of the houre-wheele at that houre, by ſtaying the Globe there, you ſhall finde that the 22 degree 30′ of Leo is the aſcendent, which is the Eaſt angle or firſt houſe, whereby you may alſo at that inſtant finde out the other three angles, that is, the Weſt, South, and North angles: for the oppoſite point of the Zodiaque to the aſcendent is the Weſt angle or 7 houſe, and that degree of the Zodiaque, which is at that inſtant right under the Meridian above head is the South angle or 10 houſe, and the oppoſite point to that beneath, is the North angle or 4 houſe, for having found the aſcendent, which is the Eaſt angle or firſt houſe, to be the 21 degree 30 minutes of Leo, the Weſt angle muſt needs be the 21 degree 30 minutes of Aquarius. Againe, the South angle or 10 houſe is the 8 degree of Taurus, and the oppoſite

poſite point that is in the North Angle, or fourth houſe which is the 7 of Scorpio.

PROPOSITION XXXVIII.

How to erect a Figure by the Globe according to Regio Montanus *his way which is called the reaſonable way, and is counted the beſt of all others.*

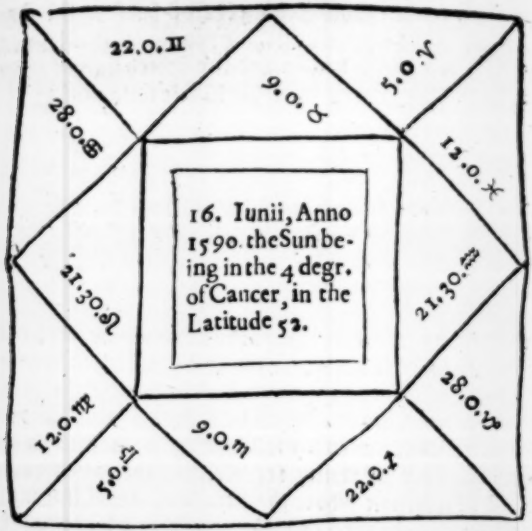
FIrſt you muſt finde out the degrée of the aſcendent, as is taught in the laſt Chapter, which is alwayes the firſt houſe, then ſtaying the Globe with ſome pretty wedges of wood being thruſt betwixt the Horizon and the body of the Globe, marke there what degrée of the Equinoctiall doth touch the Horizon at that inſtant, and number from thence upward upon the ſaid Equinoctiall thirty degrées, to the end of which thirty degrées, bring the Semi-circle of poſition, being firſt faſtned in his due place upon the Eaſt ſide of the Horizon, and looke what degrée and ſigne of the Zodiaque the Circle of poſition cutteth at that preſent, and that degrée ſhall bée the 12 houſe: then number againe other 30 degrées upon the Equinoctiall upwards towards the brazen Meridian, and to that bring the Semi-circle of poſition, marking what degrée of the Zodiaque, the ſaid Semi-circle cutteth, and that ſhall be the 11 houſe, that done, looke what degrée of the Zodiaque is right under the brazen Meridian above head, and that ſhall be the 10 houſe. Then having ſet the Semi-circle of poſition upon the Weſt ſide of the Globe, number from the brazen Meridian Weſtward upon the Equinoctiall other 30 degrées, to the end whereof bring the Semi-circle of poſition, and marke what degrée of the Zodiaque the Circle of poſition cutteth, and that ſhall be the 9 houſe, then from thence downward number upon the Equinoctiall other 30 degrées, to the end whereof bring the Semi-circle of poſition, marking there what ſigne and degrée of the Zodiaque the ſaid Semi-circle cutteth, and that

ſhall

shall be the 8 house. Now having these 6 houses, the opposite points of the said 6 houses will shew you the other 6 houses, and if you will know which houses, and also which signes are opposite one to another, marke well this Table following.

	1 to 7			♈ to ♎	
The houses opposite are these,	12	6	The Signes opposite are these	♉	♍
	11	5		♊	♌
	10	4		♋	♋
	9	3		♌	♊
	8	2		♍	♉

And to make all these things the more plaine unto you, I thought good to set down this example following. Suppose that the 16 of June, Anno 1590, and at 8 of the clock in the morning you would erect a figure to know how the 12 houses of heaven are situated at that present. First having drawne such a square figure as this here following, representing the 12 houses, learn by the last proposition who is the ascendent at that instant, and you shall find it to be the 21 degrée, 30 of Leo, which must be set in the first house, and the 28 degrée of Cancer in the 12 house, and the 22 degrée of Gemini in the 11 house, and the 9 degrée of Taurus in the 10 house, and the 5 degrée of Aries to be in the 9 house, and the 12 degrée of Pisces in the 8 house. Now the opposite house to the first house or ascendent is the 7 house, which is the 21 degrée 30 of Aquarius, for the opposite signe must alwayes have like number of degrées: then the opposite to the 12 house is the 6 house, which is the 28 degrée of Capricorne, and the opposite to 11 is the 5 house, which is the 22 degrée of Sagittarius, and the opposite to the 10 house is the 4 house, which is the 9 degrée of Scorpio, and the opposite to the 9 house is the 3 house, which is 5 degrées of Libra, and the opposite to the 8 house is the second house, which is the 12 degrée of Virgo, all which things this figure here following doth plainly shew. And if you would know what Planets should be placed in every house, you must learne that out of the Ephemerides, or out of some of the Astronomicall Tables.



Now becauſe moſt men that do ſhew the uſe of the Globes, do alſo teach therein how to find out the Latitude & Longitude of any Region, I thought good therefore to ſet downe here ſome of their manifold wayes touching the finding out of the ſame, notwithſtanding that I have already written ſomething therof in the ſecond part of my Sphеare in the 8.9.10.& 11. chapters.

Proposition XXXIX.

How to know the Latitude of any place or Region by any of the fixed ſtarres deſcribed in the Globe.

TAke in the night ſeaſon with your Aſtrolabe the Meridian Altitude of ſome knowne ſtarre that is to be found in the Globe, then having brought the ſtarre under the brazen Meridian, turne the Meridian up and downe in the nickes of the Horizon

Horizon, untill the same starre have the said Altitude in the brazen Meridian which you found it to have in the firmament by your Astrolabe: that done, number the degrees of the Meridian contained betwixt the Pole and the Horizon, and that is the Latitude of that place.

Proposition XL.

Another way to find the elevation of the Pole.

HAving brought the Globe into an open place where the Sun shineth at noontide, and placed the same right North and South as is taught in the first Chapter, set a needle in the degree of the Sun, and bring the same to the brazen Meridian, not leaving to turne the same Meridian up and downe in the nicks of the Horizon, untill the needle cast no shadow at all, and there staying the Globe, looke how many degrees the Pole is elevated above the Horizon, for that is the Latitude of that place.

Proposition XLI.

A third way to find out the Latitude of any place without taking the Meridian Altitude of any starre.

TAke at any houre the Altitude of two knowne starres, and such as are to be found in the Globe at one selfe instant, whereof the one must be situated towards the East, and the other towards the West, then turne the Globe together with the Meridian up and downe in the nickes of the Horizon, untill you find by helpe of the Quadrant of Altitude each starre to have the selfe same Altitude in the Globe, that it had in heaven, which being done, looke how many degrees the North Pole is elevated above the Horizon, and that is the Latitude of that place. But if you would know the Latitude of any place that is towards the South Pole, then you must first place the South Pole above the Horizon, and then worke as before.

Proposition XLII.

A fourth way to find out the Latitude of any Region by any knowne fixed Starre or Planet that may be seene.

FIrst take his Meridian Altitude, and then learn to know either by the Globe, or by some Table his declination, which if it be Northerne you must subtract the same from the Meridian Altitude, if Southerne, adde it to the Meridian Altitude, so shall you have the elevation of the Equinoctiall, which being subtracted from 90, the remainder shal be the Latitude of that place, as for example, I find the Meridian Altitude of Oculus Tauri to be 53 degrees, 50′, 32″, and his declination Northward to be 15 degrees, 50′, 32″, which declination being subtracted from the Meridian Altitude, there remaineth 38 degrees, and that is the elevation of the Equinoctiall, which being subtracted frow 90, there remaineth 52 for the Latitude of that place.

Hitherto I have set downe the chiefest Propositions that are to be done by the Globe, touching the Sun and the fixed stars, and lastly shewed how to find out the Latitude of any place: wherefore now I thinke good to shew you how to find out the place of the Moone, and of every one of the rest of the Planets in the Globe, by helpe of the Ephemerides, and therby to know when every Planet riseth and setteth: and first of the Moone.

Proposition XLIII.

A briefe description of the diurnall Table set downe in Stadius *his Ephemerides, together with the use thereof.*

BUt for as much as the diurnall Table of the Ephemerides, shewing the daily motion of the Planets, is very needful to serve divers turns, I thinke it not amisse here briefly to describe the same, and specially that of Iohannes Stadius, whose diurnall Table or Almanacke beginning

ginning at the 202 page of his booke, and at the yeare of our Lord 1583, continueth to the yeare 1606.

Of which Table every page on the left hand is divided into 9 collums. In the firſt collum whereof on the left hand are ſet downe the dayes of the moneth, firſt the Gregorian dayes, according to the Romane account, and next to that the dayes of the moneth according to our Engliſh account, then in the front of every other collum are ſet down the Characters firſt of the Sun, and then of the other ſix Planets, that is to ſay, of the Moone, Saturne, Iupiter, Mars, Venus, Mercury, and laſt of all the head of the Dragon figured thus ☊. And right under the 7 Planets, and alſo under the head of the Dragon are ſet downe the ſignes and degrees wherein every of theſe is every day of the moneth throughout the yeare at noonetide, and in the foot of the ſaid Table is ſet downe the Latitude of every one of the 5 Planets proceeding by the dayes of the moneth divided into three parts. And in the margent of every left page are ſet downe the chiefeſt feaſts and Saints dayes that fall in every moneth throughout the yeare. Moreouer there is a Table on the right hand right againſt the left Table, in which are ſet downe firſt the dayes of the moneth, and then what coniunction or any other aſpect the Moone hath with any of the other ſix Planets, that is, with the Sunne, with Saturne, with Iupiter, with Mars, with Venus, and with Mercurie, which Planets are ſet downe in the front of the ſaid Table, and under them the Characters of ſuch aſpects as the Moone hath that day with any of the other Planets. The Characters of which aſpects are theſe here following.

☌ ☍ △ □ ✶

Whereof the firſt ſignifieth a coniunction, the ſecond an oppoſition, the third a trine aſpect, the fourth a quadrat aſpect, and the fift a ſertile aſpect.

Two Planets are ſaid to be in a coniunction when they are both in one ſelfe ſigne. And to be in an oppoſition when they are in two ſeuerall ſignes oppoſite one to another. For then they be diſtant one from another 6 ſignes. And they are ſaid to be in trine aſpect when they be diſtant one from another by foure ſignes. And to be in a quadrat aſpect when they are diſtant

one from another, by three signes. And to be in a sextile aspect, when they are distant but two signes one from another.

Proposition XLIV.

How to find out the place of any Planet by the Ephemerides.

NOw to find out the place of any Planet, or of the head of the Dragon by this diurnall Table, you must first seeke out the day of the month in the first collum of the left Table, right against that on your right hand in the said left Table, you shall finde in the common Angle right under the Planet or Dragons head (which soeuer of them you seeke) the signe and degree wherein the said Planet or Dragons head is the said day at noonetide.

And to find out the aspects which the Moone hath with any of the Planets the same day, you must resort to the other Table on the right hand, obseruing like order as before.

The Example.

As for example: the 21 of Aprill 1592, which is the first of May, according to the Romane account, I find by the Table on the left hand, the Sunne to be in the 10 degree, 50′ of Taurus, the Moone to be in the third degree, 47′ of Capricorne, Saturne to be in the 8 degree, 10′ of Cancer, Iupiter to be in the 18 degree 28′ of Sagittarius, Mars to be in the 12 degree, 6′ of Gemini, Venus to be in the 2 degree, 0′ of Aries, and Mercurie to be in the 6 degree, 20′ of Taurus, and the head of the Dragon to be in the 29 degree, 45′ of Gemini.

And right against this in the Table on the right hand you shall find the Moone to be in a trine aspect with the Sunne, to be in an opposition with Saturne, to be in a true aspect with Mercurie,

Thus

Thus having briefly ſhewed the uſe of the diurnall Table, I will ſhew you now how to finde out the Latitude of the Moon as well North as South, by help of Stadius his Table, ſet down in the 112 page of his Ephemerides, and firſt I will briefly deſcribe the ſaid Table.

Proposition LXV.

A brieſe deſcription of the Table of Stadius *ſet down in the 112 page of his Ephemerides, to find out thereby the daily Latitude of the Moon, be it North or South, together with the Canon or Rule thereof plainly declared by example.*

THis Table is divided into eight collums, whereof the firſt on the left hand contayneth the degrees of every ſigne ſet down in the front of the Table, which degrees are to be counted deſcending from 1 to 30, for ſo many degrees there be in every ſigne: and the laſt collum on the right hand contayneth the like number of degrees belonging to the ſignes ſet down in the baſe or foot of the ſaid Table, and this number aſcendeth upward from 1 to 30, and for that purpoſe it would not have bẽn amiſſe to have ſet over each head of thoſe two collums this word Gradus, next under the word Signa. And of the other ſix collums the firſt thẽ on the left hand do contayn the degrees, minutes, and ſeconds of the North Latitude, and the other three towards the right hand do contayn the degrees, minutes, and ſeconds of South Latitude. Moreover, the twelve ſignes are to be numbred in the front from the third collum on the left hand from 1 to 5 forward toward the right hand, and at the foot from 6 to 11 backward towards the left hand, ſet down in Arithmeticall figures.

The Rule or Canon, together with a plaine example shewing the use of the Table.

FIrst, knowing the day of the month, resort unto the diurnall Table of the motion of the Planets in the Ephemerides, and having there found out the motion or place of the Moone, and also of the Dragons head, answerable to the day wherein you seeke, subtract the place of the Dragons head from the place of the Moone, which is easily done, so often as the Arch of the Moone is greater, that is to say, containeth more signes and degrees than the Arch of the Dragons head, beginning your account in both Arches from the first point of Aries. But if the Arch of the Moone be lesser than the Arch of the Dragons head, so as you cannot make your subtraction, then you must adde to the place of the Moone 12 signes, which is 360 degrees, and you must adde also thereunto the number of so many signes as are contained betwixt the first point of Aries, and the first point of that signe wherein the Moone is at that present, which signe it selfe is not to be numbred, and when you can take out of that whole sum the place of the Dragons head, you must first adde to the said place of the Dragons head the number of so many signes as are contained betwixt the first point of Aries, and the first point of that signe wherein the Dragons head is at that instant, but not the signe wherein it is, and then having made your subtraction, remember alwaies to take out of that remainder 90 degrees, which is three signes, so oft as you have need to adde 12 signes to the place of the Moone, and not otherwise, and with that remainder you must resort to the foresaid Table of the Moones Latitude, as for example.

The Example.

Suppose that you would know what Latitude the Moone had the first of November 1590, here resorting to the diurnall Table of the Ephemerides, you find according to the day propounded, the place of the Moone to be in the 16 degree, 49 of Taurus, and

the

the place of the Dragons head to be in the 28 degrée 14′ of Cancer. Now according to the Rule before given, you must take the place of the Dragon here, which is 28 degrées, 14′ of Cancer, out of the 16 degrées, 49′ of Taurus, which is the place of the Moone, and because you cannot take the greater summe out of the lesser, you must adde to the lesser summe 12 signes, which make 360 degrées, and also one signe, for Aries going next before Taurus, in which signe the Moone is, so shall you make the whole sum to be 13 signes, 16 degrées, 49′, out of which sum you must subtract the Dragons head, which with the signes that go next before Cancer, counting from the first point of Aries, do make 3 signes, 28 degrées, 14′, which being subtracted out of 13 signes, 16 degrées, 49′, there remaineth 9 signes, 18 degrées, 35′, out of which you must also subtract 90 degrées, which is 3 whole signes, and so you find the remainder to be 6 signes, 18 degrées, 35′, with which last remainder you have to enter into the Table of the Moones Latitude, in the foot whereof you shall find 6 signes, and in the last collum on the right hand 18, and in the next collum towards the left hand, and in the common Angle answerable as well to the said 18 degrées, as also to the 6 signes, you shall find the Latitude of the Moone to be 4 degrées, 45′, and 17″, (which seconds may be very well omitted) and her Latitude to be South. But now because there are 35′, more annexed to the 18 degrees of the foresaid remainder, you must find out a proportionall part answerable to those minutes, which is to be done thus.

Take out of the Table the whole Latitude answerable to 6 signes and 19 degrées, which is one degrée more, so as now the Latitude of the Moone is 4 degrées, 43′, omitting the seconds. Then subtract 4 degrées, 43′, out of 4 degrées, 45′, and there remaineth 2′. Now to find out a proportionall part answerable to the former 35′, you must say thus. If 60′ require 2′, what shall 35′ require? and the Quotient yeldeth 1′, 10″, which being subtracted out of 4 degrées, 45′, there will remaine 4 degrées, 44′, and so much was the South Latitude of the Moone at that present day.

How

Proposition XLVI.

How to know the true place of the Sunne or Moone, or of any other Planet every houre of the day throughout the yeere.

But now because that to finde out the true place of the Moon or of any other Planet in the Globe, to worke thereby certainly and truly, it is not enough to know their places in the Zodiaque at noontide, unlesse you know the same at the very houre in which you seek. Stadius teacheth a briefe Rule to find out the true place of any Planet at what houre soever you desire, by help of a short Table set down in the 109 page of his Ephemerides, which Rule and Table he borrowed of Reinholdus. And this Table consisteth of three collums, in every front whereof are set first the degrees, minutes, seconds, and thirds, and under them minutes, seconds, thirds, and fourths. And note that the first row of numbers on the left hand signifieth sometime degrees, and sometime minutes, either of which do extend in this Table to 60, and to 61, right against which row in every collum is set down on the right hand the proportionall part for one houre: the Rule is thus.

The Rule.

First finde out by the Ephemerides the place of the Planet, wherein it is at noontide the same day that you seek, and also the place of the same Planet, wherein it is the next day following at noon, and subtract the lesser out of the greater, if the two places at noontide be still in one selfe signe, but if the two places be in two severall signes, then you must count how many degrees of the Ecliptique, the one place is distant from the other, and that shall be the difference, with which difference you must resort to the Table, and right against that on the right hand in the same collum wherein you found the difference, you shall also finde the proportionall part for one houre, as by this example you shall more plainly understand.

The

The Example.

Suppose then that you desire to know the true place of the Sunne or of the Moone, or of any other Planet at five of the clocke in the afternoone, the 30 of December, 1591. at which day you find the Sunne at noonetide to be in the 18 degree, and 7 minutes of Capricorne, and the next day at noone to be in the 19 degree, and 8′ of the same signe, the difference whereof you find by subtraction to bee one degree and one minute, with which difference you must enter into the Table, and seeing for one degree in the first collum on the left hand, you find next unto that on the right hand 2′, 30″, then for one minute which before was named one degree, you find next unto it 2′, 30‴, which being added to the former summe last found, maketh 2″, 32″, 30‴, which is the proportional part for one houre. Then having multiplyed that by 5 houres to serve for the clocke in the afternoone, you shall find the Product to be 12′, 42″, 30‴, which being added to the first Meridian place, which is 18 degrees and 7 minutes of Capricorne, maketh in all 18 degrees, 19′, 42″, 30‴. And remember that if your difference be only minutes, then the body of the Table doth shew the proportionall part. But if the difference doth containe degrees, then the fourths must bee made thirds, and the thirds seconds, the second minutes, and the minutes degrees. and this Table serveth for the 7 Planets for ever. Notwithstanding Stadius setteth downe another Table to find out thereby the proportionall moving of the Moone, serving as well for houres as for minutes of houres, which Table beginneth at the 144 page, and endeth at the 184 page of his booke.

In the front of which Table in every page are set downe the differences of the two places of the Planets, which you have found by subtracting the lesser out of the greater, if the Planet be at both noonetides in one selfe signe, but if she bee at the two noonetides in two severall signes, then such difference is to bee accounted upon the Ecliptique line, to know how many degrees the one place is distant from the other: and

as

as for the minutes, if there be any, you may know the difference thereof by subtracting the lesser number out of the greater. And in the outtermost collum on the left hand are set downe the houres and minutes marked in the foot with the letter H. signifying houres, and under that with the letter M. signifying minutes, whereof the houres proceed but to 24, but the minutes extend to 60, which make one houre proceeding by even numbers in this sort, 1. 2. 4. 6. 8. &c. and therefore not finding that houre or minute which you seeke in the said collum, you must take the next number which is lesser by one, & so make it up by adding the first, & onely adde one unto it, and in each common angle you shall finde the proportionall part that is to be added to the first place of the Planet, answering to the day of the month wherein you sought. All which things you shall more plainely understand by this one example.

The Example.

Suppose then that you would know the true place of the Moone at 5 of the clocke, 17′, in the afternoone the 28 of December 1591, and looking in the Ephemerides you find the place of the Moone to be the same day at noone tide in the 26 degree, 12′ of Libra, & the next day at noone tide to be in the 8 degree, 17′ of Scorpio, here by numbring how many degrees are contained in the Ecliptique line betwixt those two places, and by subtracting the lesser number of minutes out of the greater, you shal find the difference to be 12 degrees, 5′, with which difference you must resort to the Table of proportionall parts, & there having found the said difference in the front of the 13 page of the said Table, looke in the first collum on the left hand for the houres & minuts according to the Rule before set down. As here in this example because you cannot finde 5 houres, you take foure, right against which on the right hand in the common angle you shall find two degrees, 0′, 50″, then for one houre to make the 5 houres you shall find in the common angle 3′0, 12″, that done, seek out the 17′ in the first collum, which number not being there, you must take 16 against which in the common angle you shal find 8′, 3″, 23‴, and for

for the one minute which is to be added to 16, you ſhall find in the common angle againſt that one minute 30″, 12‴, and by adding all theſe ſummes together you ſhall finde the proportionall part to be 12 degrées, 39′, 35″, 32‴, which being added to the place of the Moone at Noontide firſt found in the Ephemerides, maketh in all 28 degrées, 51′, 35″, 32‴ of Libra, which is the true place of the Moone for that houre. But you have to note, that the denominations of the numbers contayned in the common angles of proportionall parts be not allwayes like, for when they are to anſwer houres, then the firſt number on the left hand in every angle ſignifieth degrées, and the reſt minutes and ſeconds, but if they have to anſwer minutes of houres, then the firſt numbers do ſignifie minutes, and the reſt ſeconds and thirds, as you may eaſily perceive by examining the former example. But now to returne to my firſt intention, which was to ſhew you how to find out the true place of every Planet in the Globe, you have to underſtand that having found out the true place of any Planet at the day and houre wherein you ſéke by ſuch meanes as is before taught, then reſort to the Celeſtiall Globe, and having ſet the ſame at your Latitude, and alſo rectified the houre-whéle according to the day wherein you ſéke, Suppoſe that the 26 of May 1592, you would know in what part of the Globe the Moone is to be found at 5 of the clock in the afternoone. Here firſt you muſt know her place at noone the ſame day, which is the 14 degrée, 28′ of Aries, and alſo her place the next day at noone, which is the 29 degrée, 0′, of the ſame ſigne: Now by taking 14 degrées, 28′, out of 29 degrées, you ſhall find the remainder to be 14 degrées, 32′, with which difference you muſt reſort to the Table ſet downe in the 109 page. And by working as before is taught, you ſhall find her place or longitude to be at five of the clocke in the 17 degrée 23′, 6″, 43‴, of Aries, which being counted upon the Ecliptique line of the Globe, lay your ſemicircle of Longitude and Latitude to that point, and having learned her Latitude by helpe of the Table of Latitude before mentioned, by which you ſhall find her Latitude to be at that time 4 degrées, 46′, to the Southward, then having counted that Latitude upon the ſemicircle of Longitude and Latitude

tude, make there a marke upon the Globe, for that is her very place at that instant, that is to say, at 5 of the clocke in the afternoone the 26 day of May 1592.

Now if you would know when she riseth and setteth, you have no more to do but to bring her place before marked on the Globe unto the Horizon on the East part, and the Inder of the houre-wheele being rectified as is before said, will shew the houre of her rising above the Horizon, and by bringing her place to the West part of the Horizon, the Inder will shew the houre of her setting, and by bringing her place to the brazen Meridian, you shall know at what houre she is full South. The like Tables you shal find also in Stadius to find out the true place of every other Planet at any houre, as of Saturne, Iupitur, Mars, Venus, and Mercury, which Tables do begin at the 128 page, and end at the 143 page of his Booke, the order of working by which Tables is like in every respect unto that of the Moone last taught: by which Tables you may find out the true place of any other Planet in the Globe at any houre of the day or night, and thereby to know the houre of his rising and setting, if you rightly observe the Rules before taught touching the use of the foresaid Tables. And note that you may find out the place of the Moone by the Globe without the helpe of any Ephemerides, by such wayes as here do follow.

Proposition XLVII.

How to find out the place of the Moone by the Globe when she is above the Horizon, without the helpe of any Ephemerides or other Table whatsoever.

HAving set the Globe at your Latitude, and placed it so as it may rightly answer the foure quarters of the World, take the Altitude of the Moone with your Astrolabe or Quadrant, and marke therewith whether she be at that present East, or West, that is to say, on the East side of the Meridian, or past the Meridian: that done, take the Altitude of some fixed starre which you know, and is to bee found

found in the Globe, and alſo at that time, is above the Horizon, marking therewith in what part of the firmament the ſaid ſtar is, and with your croſſe-ſtaffe take the diſtance betwixt the Moone and that ſtar. Then having theſe three things, that is, the Altitude of the Moone, the Altitude of the ſtar, and alſo the diſtance betwixt the Moone and the knowne ſtarre; Move the Globe together with the Quadrant of Altitude to and fro, untill you have made the Moone to have the ſame Altitude and like place in the Globe, that you found it to have in the firmament, and there make a marke upon the Globe. Then bring the Quadrant of Altitude towards the ſtar, that the ſtar may have the like Altitude and like place in the Globe that it had in the firmament, and there having ſtayed the Globe that it may not move, take with your Compaſſe upon the Equinoctiall the diſtance betwixt the Moone and the ſtar before found by the croſſe-ſtaffe, and keeping your Compaſſes at that wideneſſe, put the firme foot of your Compaſſes in the fixed ſtar, and ceaſe not to move the other foot together with the Quadrant of Altitude towards the marke of the Moones Altitude, untill you make them to meet, for there is the place of the Moone.

Proposition XLVIII.

Another way to find out the place of the Moone without taking the Altitude of any Starre.

Seeke by your croſſe-ſtaffe to know the diſtance betwixt the Moone and any two ſtars that you know, and are to be found in the Globe. That done, draw upon the Globe on either ſtarre an obſcure Circle, according to the diſtance of the Moon from either of thoſe two ſtars, which two Circles will cut or croſſe one another but in 2 points, the one whereof is the place of the Moone, and which of thoſe places it ſhould be, your eye will eaſily tell you. And by this meanes it were no hard thing (as Gemma Friſius ſaith) for our Seamen in theſe daies to find out all the ſtars that be in the nether Hemiſpheare

sphere and were unknown to Ptolomie and to the other ancient Astronomers, and to cause them to be set downe in the Globe, yea and by this Art the places of the rest of the Planets may be found out as well according to their Latitude as Longitude.

Howsoever Gemma Frisius saith, that by knowing the true place of the Moone in the Zodiaque, you may also find out therby the unknowne Longitude of any Region.

Proposition XLIX.

How to find out the Longitude of any Region.

HAving found out the place of the Moone in the Zodiaque, you must first know the very houre of her being in that place, and then learne by some Ephemerides, or by the Tables of Alphonsus, at what houre the Moone doth enter into the selfe same degrée of the Zodiaque in some other Region or Towne, whose Longitude you already know: and having reduced the houres to 24, take the lesser number of houres out of the greater, the remainder whereof must be reduced out of houres and minutes into degrées thus: Multiply the houres by 15 and the minutes of houres by 4, so shall you have the degrées of the Equator contained betwixt the two Meridians. And such distance so intercepted is called the difference of Longitude, which difference you must adde to the knowne Longitude, if the houres in that place were more in number, but if the houres were lesse in number, then you must subtract the foresaid difference from the knowne longitude, so shall you collect the unknowne Longitude of that place or Region which you séeke, and how farre it is distant from the fortunate Iles.

Propo-

Proposition L.

Another way to find out the unknowne Longitude of any place by the Globe.

HAving set the Globe at your Latitude, and rectified the houre-whæle by the seventh Proposition, bring the place whose Longitude you know to the brazen Meridian, and direct the Inder of the houre-whæle to that houre in which the Moon doth occupy the former defined place in that Region or Town: that done, leave not to turne the Globe untill the Inder of the houre-whæle come to that houre in which you sought the unknowne place of the Moone, and the degrees of the Equator which the brazen Meridian cutteth, will shew the unknowne Longitude of the place which you seeke.

To the end of this Treatise I have thought good to adde a briefe description of the two great Globes, lately set forth by M. Molineux at the charges of M. Sanderson, and therewith to set down a briefe description of Sir Francis Drake his first voyage into the West and East Indies, and also the voyage of M. Thomas Candish, both whose voyages, & what course they held are to be seene by helpe of two small lines drawn on the Terrestriall Globe, of which lines the one is red, shewing the voyage of Sir Francis both outward and homeward, and the other line is blew, shewing in like manner the voyage of M. Candish.

A briefe description of the two great Globes lately set forth by M. Sanderson.

THese Globes do differ in a manner nothing at all from the Globes of Mercator, touching the Circles before described, but only in the Horizon, for the Horizon of these great Globes is divided into 13 spaces as followeth.

Whereof the first narrow innermost space

next unto the body of the Globe, containeth the degrées of the Zodiaque.

The ſecond containeth the numbers of the ſaid degrées proceéding from 10 to 30 in ebery ſigne.

In the third ſpace are ſet downe the names and the Characters of the 12 ſignes, and alſo the Characters of the Planets that goberne the ſaid ſignes.

In the fourth ſpace are ſet downe the letters of the dayes of the weéke.

In the 5 and 6, are ſet downe the numbers of the dayes and names of the months accoꝛding to the ancient Calender.

In the ſeuenth the feaſtiball dayes.

In the 8 and 9 ſpace the number of the dayes and names of the months accoꝛding to the new Roman Calender.

In the 10 and 11, are ſet downe the numbers of the dayes and names of the months, accoꝛding the true Calender lately calculated by a moſt excellent Mathematician and mine old acquaintance M. Dee of Mortlake, as I conieéture by the letters I. D. ſet downe upon the Hoꝛizon.

In the 12 are ſet down the Engliſh names of the 32 Rumbs oꝛ winds of the Mariners compaſſe.

In the 13 and outermoſt ſpace are ſet downe the Latine names of the ſaid 32 winds.

But the Pappe which coꝛereth M. Molineux his Terreſtrial Globe differeth greatly from Mercator his Terreſtrial Globe, by reaſon that there are found out diꝛers new places aſwell towards the Noꝛth Pole, as in the Eaſt and Weſt Indies, which were unknowne to Mercator. They differ alſo greatly in the names, Longitudes, Latitudes, and diſtances of ſuch places as haue béene heretofoꝛe ſet downe, not only in Mercators Globe, which was made many yéares ſince, but alſo in diꝛers Pappes moꝛe lately made, but who goeth nigheſt the truth I dare not iudge, becauſe I was neuer in thoſe places. But as touching the Map of ſtars which coꝛereth the Celeſtiall Globe of M. Molineux, I do not find it greatly to differ from that of Mercator, ſauing that M. Molineux hath added to his celeſtiall Globe certaine Southerne Images, as the Croſſe, the Southern Triangle,

angle, and certaine other stars, whereof some do signifie Nocs Dove, and others do signifie the Image called Polophilax: the Images whereof are not here set down, but you shall find them described in Plancius his Map, made in the yeare 1592, whose Longitudes, Latitudes, and declinations, how truly they are set downe in the said Globe or Map, I am not able to judge. He setteth downe also two clouds nigh unto the South Pole, but not the use thereof. Moreover to this breefe description of M. Molineux his two Globes, I thought good to adde the first voyage of Sir Francis Drake, and of M. Thomas Candish, set forth by two lines, the one red, and the other blew, described in the Terrestriall Globe of the said M. Molineux, and also how far Sir Martin Furboscher sailed northward, as followeth.

The first voyage of Sir Francis Drake *by Sea unto the West and East Indies both outward and homeward*

IN the great Terrestriall Globe lately put forth by M. Sanderson and M. Molineux, the voyage as well of Sir Francis Drake, as of M. Thomas Candish, is set downe, and shewed by helpe of two lines, the one red, and the other blew, whereof the red line proceeding first from Plymouth, doth shew what course Sir Francis observed in all his voyage, aswell outward as homeward, and the blew line proceeding also from Plymouth, sheweth in like manner the voyage of M. Candish, and in that Globe is also set downe how farre Sir Martin Furbosher discovered towards the North parts. But first I will describe unto you the voyage of Sir Francis Drake that worthy Knight and most noble Neptune, according as that red line directeth in the said Globe.

First parting from Plymouth he sailed with a North North-East Wind to an Ile called Mogodore, upon the Coast of Marocello, which place is not named in M. Molineux his Globe, and that place having in North Latitude 32 degrees is distant from Plymouth according to that course which the Red Line

theweth 420 leagues. In this Ile he built a little Pinnis or Shallop, and from thence he sailed to Cape Dalguere which is further Southward, and having in North Latitude 30 degrees, is distant from Mogodore about 40 leagues, and from thence he sailed to the Iles Canary which are somewhat more Westward, and having 27 degrees, 30' in North Latitude, are distant from the Cape Dalguere about 100 leagues, and from thence he sailed to Capo Blanco which is more Westerly, and having in North Latitude 21 degrees, is distant from the Canaries 130 leagues and somewhat more, and from thence he sailed to the Iles of Capo Verde, which having in North Latitude about 15 degrees, are distant from Capo Blanco about 140 leagues. And from thence to the great Cape of S. Augustine, which having in South Latitude about eight degrees, is distant from Capo Verde 500 leagues, and from thence he sailed more Westerly unto the mouth of the River called Rio de Plata, which having in South Latitude 36 degrees, is distant from Cape S. Augustine, 760 leagues, and from thence to the Port S. Iuliano, having in South Latitude about 50 degrees, whereas one Doughtie was executed for conspiracy, and this Port is distant from Rio de Plata 370 leagues. And from thence he sailed to the Cape Virgine Maria, which having in South Latitude 52 degrees, 30', is distant from Port S. Iulian 50 leagues, and from thence striking in betwixt the Ile, whose Northeast Cape is called the Ile of the name of Iesus, and the Port Famine, he entred into the straight Magellane, which having in South Latitude 53 degrees, 30', is distant from the Cape Virgine Maria 60 leagues, and from thence he passed thorow the Magellane straights to the Cape de Sancto Spirito, which is a Cape of the South land, having in South Latitude 52 degrees, 20', and is distant from Cape Virgine Maria about 160 leagues, from thence he sailed somewhat Westerly about 20 leagues, and there fetching a turne about certaine Ilands called Las Anegadas, he tooke his course Northward alongst the West Coast of America unto the Ile Lima, which having in South Latitude 12 degrees, is distant from the Ilands called Las Anegadas 840 leagues, and from thence he sailed still Northward unto Cape Guija, which

having

having in South Latitude 6 degrées, 10', is distant from the Ile Lima 160 leagues, from thence still Northward he sailed to Cape S. Francesco which having in North Latitude 1 degrée, 30 minutes, is distant from Cape Guija 170 leagues, from thence he sailed still Northerly to the Cape Mondecino, which is in the land called Quivira, and this Cape having in North Latitude 40 degrées is distant by that course from S. Francesco 1740 leagues, from thence he sailed still Northward unto a certaine Bay in the West part of Quivira which he named Nova Albion (that is to say) new England, having in North Latitude 46 degrées, and is distant from the Cape Mondecino 140 leagues. And this was the furthest part of his voyage outward, in which voyage he sailed in all 5780 leagues, and from this Bay Sir Francis himselfe (as I have heard) was of very good will to have sailed still more Northward, hoping to find passage thorow the narrow Sea Anian, which Sea is not set down by M. Molineux in his Terrestriall Globe as a straight, but rather as a main Sea, bearing in breadth 400 leagues, and so from thence to have taken his course Northeast, and so to returne by the Iles Crockland and Groyneland into England: but his Mariners finding the coast of Nova Albion to be very cold, had no good will to saile any further Northward, wherfore Sir Francis was faine to come back againe Southward to Mondecino, which (as hath bin said before) is distant from the foresaid Bay of Nova Albion 140 leagues. From thence he sailed in a manner right Southwest to the Iles Molucces, and touched at the Iles Ternate, Tidore, Machian, and Motil, which are nigh unto the Ile Gilolo, which is right under the Equinoctiall, amongst which Iles he remained a certaine time, of which Ilands the Ile called Ternate having about one degree, 30' of North Latitude, is distant by that course from the Cape Mondecino 1140 leagues, & from thence he sailed Southwest until he came to the West end of the Ile Iava major, which having in South Latitude nine degrées, 30 minutes, is distant from the Ile Ternate by that course 620 leagues, and from thence he sailed still Southwest to the Cape di Buona Speranza which having in South Latitude 35 degrées, is distant from Iava major 1660 leagues, then from

Capo di Buona Speranza, he making his course Northwest sailed to an Iland called Sierra Liona, which is upon the coast of Affrique, and having in North Latitude 7 degrees, 30', is distant from Capo di Buona Speranza 1100 leagues, then from thence he sailed towards the Iles of Capo Verde until he came to the 14 degree of North Latitude right under the first Meridian, which point is distant from the Iland Sierra Liona according to that course 320 leagues, and from thence he sailed Northward nigh to the Iles called Azores on the West side thereof, which having of North Latitude 40 degrees, are distant by that course from the Iles of Capo Verde 600 leagues, from whence he directed his course Northeast to Plymouth, which having in North Latitude 51 degrees, is distant by that course from the Azores 500 leagues, so as in his returne from Nova Albion to Plymouth he sailed in all 6080 leagues, which if you adde to the number of leagues of his outward voyage before set downe, which is 5780 leagues, you shall finde the totall sum of the leagues to be 11860 leagues, which is almost twice so much as the compasse of the whole world, which if you measure upon the Globe by the Equinoctiall line containing 360 degrees, and do allow for every degree therof 60 Italian miles, you shall find the number of such miles to amount to 21600 miles, which by allowing three miles to a league, do make no more but 7200 leagues. But if it might please some expert Mariner to write a perfect Diarie of his whole voyage, shewing how much he sailed in a day, and what watering places he found and where he touched, and how long he rested in any place, and what good Ports and Havens he found, and what anchorage good or bad, and what manner of people, what trade of living, and what kind of building and government they used, as well in civill as in martiall affaires: Also in what Aire they lived, and whether the ground were fertile or barren, dry or well watered with floods and fountaines, what mountaines, what mines, what woods or forrests, what beasts, foules, or fishes, fruits, hearbes, plants, or other commodities he found therein, and in what manner of seas he sailed, and what winds and currents were most rife in every place: Also what rocks, sands,

sholdes,

sholdes, and all other places of danger and perill, and by what markes such places are to be shunned: And finally what Moon doth make a full Sea in every Port where he arrived, and what windes do alter any tide or current, and all other necessary accidents most meet for Sea-men to know. In thus doing, I say, he should greatly profit his Country-men, and thereby deserve immortall fame. Of all which things, I doubt not but that he hath already written, and will publish the same when he shall thinke most meet.

The voyage of M. Candish *unto the West and East Indies, described on the Terrestriall Globe by the blew line.*

THis blew line as you see taketh his beginning from Plymouth like as the red line doth, whereby you may plainly see, that M. Candish did not greatly differ in his course from that which Sir Francis held, saving that M. Candish having once passed the straight Magellane Westward, sailed not so farre Northward as Sir Francis did, for he sailed no further Northward but to the Port S. Lucas, which is almost under the Tropique of Cancer, for that Port hath in North Latitude 22 degrées, 30′, keeping alwayes a nigher course unto the maine, than Sir Francis did, and from the Port S. Lucas he sailed in a maner Southwest about 320 leagues, and then he directed his course West ward towards the Moluccas: and before he came to the Moluccas, he fetched about the Ile Catanaim, which is more Northward than Sir Francis went in those parts, and from thence he sailed full South to the Moluccas, from whence he directed his course Southwest, and passed betwixt the Iles Iava Major, & Iava Minor, which two Iles in the said great Globe are made to have one selfe Latitude (that is to say) about 10 degrées of South Latitude, counting from the Equinoctiall to the Parallel which passeth thorow both the Iles. But in all other

Globes and Pappes lyeth minor Hamoth 10 degrees more to the South, and is placed behinde the South Promontory called the land of Besch. Then having passed betwixt the foresaid two Iles, he held in a manner the like course that Sir Francis did in his returne to Plymouth, which the blew line both shew so plainly as it needeth none other description. Now as touching Sir Martin Furbishers voyage, because his owne description thereof is in Print, nothing is set down in this Globe, but only the ouermost end of his voyage named here Furbishers straits, having in North Latitude about 63 degrees, in the mouth of which straights is a little Iland called Hales Iland on the right hand, and on the left hand another little long Iland called Leicesters point. Truly this knight for his dangerous venture, aswell in this voyage as in diuers other his worthie services done upon the Sea, deserueth great commendation, and I wish with all my heart that he and such like might be much made of, and rewarded according to their desert. And thus I leave to speake any further of M. Molineux his Globes, the use whereof is to be learned by those Propositions which I have heretofore set down, touching the use of Mercator his two Globes: for the practice and manner of working both by his Globes and by these Globes, is all one.

A plaine and full deſcription of *Petrus Plancius* his univerſall Map,

ſerving both for Sea and Land, and by him lately put forth in the yeere of *our Lord* 1592.

In which Mappe are ſet downe many more places, aſwell of both the Indies as of Affrique, together with their true Longitudes and Latitudes, than are tobe found either in *Mercator* his Map, ~~or in~~ any other moderne Map whatſoever: and this Mappe doth ſhew what riches, power, or commodities, what kinds of beaſts both wilde and tame, what plants, fruits, or mines any Region hath, and what kinds of Marchandizes do come from every Region.

Alſo the divers qualities and manners of the people, and *to whom they are ſubiect. Alſo who be the moſt mighty and* greateſt Princes of the world: A Map meet to adorne the houſe of any Gentleman or Merchant that delighteth in Geographie: and therewith this Booke is alſo meet to be bought, for that it plainly expoundeth every thing contained in the ſaid Mappe.

Written in our mother tongue by M. *Blundevill.*

Anno Domini 1594.

Imprinted at LONDON by *Richard Biſhop* 1636.

IN DOCTISSIMI VERE-QVE GENEROSISSIMI VIRI THO. BLVNDEVILI IN PETRI PLANCII TABVLAM GEOGRAPHICAM & Hidrographicam elucidationes *Gualteri Haugbi* Δικατσράσικον.

PLancius in tabula terras descripsit & undas,
Quæcunque & toto condidit orbe Deus:
Multiplices horum partes, Regumque per illas
Sceptra superba, simul totius orbis opes,
Sed solis Gallis hæc Plancius, atque Latinis,
Inter & hos, Doctis scripserat, haud alijs.
Tu Generose tuis patrio hæc Idiomate clarè,
Blundevile refers, Cunctaque nota facis.
Tu simul hæc auges, lucemque his addis, & horum
Vsum multiplici non sine fruge doces.
Nec solum doctis, sed & omnibus hæc Idiotis:
Perspicua ut pateant, tu brevitate facis.
Plancius hæc alijs, tu nobis omnia tradis.
Tuque tuis Anglis Plancius alter eris.

A plain and full deſcription of *Plancius* his univerſall Mappe, ſet forth in the yeere of our Lord 1592, written in our mother tongue by *M. Blandevill.*

IN this Mappe, as you ſee, are drawne with red Inke two lines or Diameters croſſing one another with right Angles in the very midſt of the Mappe, whereof the Perpendicular Diameter paſſing thorow the Iles Azores, and alſo thorow the Iles of Capo Verde, ſignifies the firſt Meridian and Arcltree of the world, at the upper end whereof is ſet the North Pole, and at the nether end the South Pole. And the other overthwart Diameter ſignifieth the Equinoctiall, and alſo the line of Eaſt and Weſt, that is to ſay, Eaſt on the right hand, and Weſt on the left hand. And in this line are ſet downe the degrées of Longitude, which are to be counted from the foreſaid firſt Meridian upon the ſaid Equinoctiall towards your right hand from one degrée to 180, ſet downe in Arithmeticall figures thus, 10, 20, 30, and ſo forth untill you come to 180, which is the Eaſt Longitude of the world: and the Weſt Longitude beginneth on your left hand, whereas is ſet downe 190, and then 200, and ſo forth untill you come to 360 degrées, which is the whole circuit of the Equinoctiall, and of the whole earth. And in the firſt Meridian are ſet downe the degrées of Latitude, which do proceed from the Equinoctiall to either

eyther of the Poles from one degrée to 90, written in Arithmeticall figures thus, 5, 10, 15, and so forth to 90, which degrées do proceed with equall distances from the Equinoctiall to eyther Pole, and the like degrées of Latitude are also set downe upon the two outermost Meridians, as well on the right hand, as on the left. And on each side of the Equinoctiall are drawne with red Inke the two Tropiques, that is to say, the Tropique of Cancer, and the Tropique of Capricorne, each one being distant from the Equinoctiall 23 degrées, 28', which is the greatest declination of the Sun, and towards each Pole are also drawn with red Inke the two Circles both Arctique and Antarctique, whereof the Circle Arctique passeth thorow the northerly part of Island, having in Latitude 66 degrées, 30', and the Circle Antarctique passeth thorow the like degrées of Latitude towards the South Pole, the distance of each of those Circles from eyther Pole is equall to the greatest declination of the Sun. And these 4 Circles are Parallels to the Equinoctiall, bounding the 5 Zones, that is, the 2 cold, the 2 temperate, and the hot Zone which lieth in the midst of the world betwixt the 2 Tropiques. And on the left hand of West part of the Mappe are set downe from the Equinoctiall upward towards the North Pole, what number of miles and seconds of miles do belong to every degrée of the North Latitude, proceeding from the Equinoctial towards the North Pole: for though that every degrée of the Equinoctial being a great Circle containeth 60 miles, yet the further that you go from the Equinoctiall towards either of the Poles, the lesser and lesser are your Parallel Circles in compasse, and therefore one degrée of every such Parallel must needs containe the fewer miles, but because ỹ sea-men do cõmonly make their account on the sea by leagues, & not by miles: Plancius here right under the former Table of miles, setteth downe the number of leagues incident to every degrée or Parallel, in descending from the Equinoctiall to the South Pole, appointing three miles to a league, and therefore he setteth down upon the very Equinoctiall 20 leagues, which is 60 miles, and next to that he setteth downe 19 leagues 59', and so proceedeth forth, diminishing till the quantity of ỹ leagues, even till you come to the very South Pole, and

on

on the right hand of the Map hard by the outermost Meridian are set downe the nine climes, and the longest day in every degree of Latitude, proceeding aswell from the Equinoctiall to the North Pole, as also from the Equinoctiall to the South Pole, from 12 houres to 187 dayes and 7 houres, which maketh the longest day to those that dwell right under the North Pole, to be halfe a yeare, and the night as much. Besides the Circles and lines before mentioned, there are set downe in this Mappe certaine flies of the Mariners Compasse, each one containing two and thirty lines, which do signifie the two and thirty Rumbs or windes of the Mariners Compasse, to know thereby how one place beareth from another, and by what wind the Mariner hath to sayle to any place whereunto hee would go: In every which flie the line of North and South may serve in stead of a Meridian, and the line of East and West may serve as a Parallel, by helpe whereof you may the more readily take with your Compasses the Longitude and Latitude of any place contained in the Mappe, in such manner as is taught in my first Treatise of Universall Mappes. Also in the very front of his Mappe he setteth downe the numbers of foure and twenty houres, every houre containing fifteene degrees of the Equinoctiall, which houres do beginne on the right hand, and so proceed to the left, whereof the twelfth houre is placed at the end of that Meridian which passeth thorow the Fortunate Iles. Now betwixt the 72 and 86 degrees of North Latitude he setteth downe two long Ilands extending from the West towards the East, somewhat beyond the first Meridian, and from the said Meridian more Eastward he setteth downe other two long Ilands, affirming that the North Ocean Sea breaking in betwixt these Ilands with nineteene gates or entrances, maketh foure straits, and is continually carried under the North Pole, and there is swallowed up in the bowels of the Earth, and he saith further, that right under the North Pole there is a certaine blacke and most high rocke, which hath in circuit thirty and three leagues, which is ninty and nine miles, and that the long Iland next to the Pole on the West is the best and most healthfull of all the North parts. Next to the foresaid

Ilands

Ilands more Southward, he setteth downe the Ilands of Greckland and Groneland, making them to have a farre longer and more slender shape then all other Mappes do: at the East end of the third long Iland, is a straight having five gates or entrances, which by reason of their narrownesse and swift course of Streame are never frozen. If this be true, I merualle how any ship durst enter thorow any of those straights to discouer the North seas of any of those Ilands, and how and where it came out againe: Moreouer at the East end of the last Iland somewhat to the Southward, he placeth the Pole of the Loadstone which is called in Latine Magnes, euen as Mercator doth in his Mappe, who supposing the first Meridian to passe thorow Saint Mary or Saint Michael, which are two of the outermost Ilands of the Azores Eastward, placeth the Pole of the Arctic in the seuenty five degree of Latitude, but supposing the first Meridian to passe thorow the Ile Corvo, which is the furthest Ile of the Azores Westward, he placeth the Pole of the Loadstone in the seuenty seuen degree of Latitude. I thought good to seuer the Ilands last before mentioned from the body of the Mappe, as parts belonging rather to the North Pole, then to Europe, Asia, Affrica, or America: for if Virgil did not let to say that England was Penitus extra sidera absorbe, me thinkes that I may much more rightly say the like of these Ilands, notwithstanding Plancius maketh the first two long Ilands, and also Groneland and Greckland, to be part of Mexicana, which me thinks is not meet, sith they be diuided by the North Sea: likewise he maketh the land which is under the South Pole, and is not as yet discouered, to be part of Magellanica, which (in mine opinion) ought not to be so, sith it is not only diuided from Magellanica, by the straight Magellanicum, but also from Affrique and from the East Indies by the great Northerne Ocean. And I beleeue that when the Southland shall be all discouered, it will containe twice so much land as Magellanica doth, and then I doubt not but that the Geographers will giue it some other name, and make many diuisions thereof. In the meane time I will follow Plancius his olone mappe of the world, which greatly differeth from that of Mercator, and of all

other

other moderne Geographers, for they do divide the whole earth but into foure parts, that is to say, Europe, Affrique, Asia, and America, but Plancius by dividing America into three parts, that is, into Mexicana, Peruana, and Magellanica, divideth the whole earth into six parts, that is to say, Europe, Asia, Affrique, and into the three parts of America last mentioned, according to which division, he describeth the earth in the French tongue in sixteene pages, set downe at the foot of his Map: the foure last pages whereof do only containe the interpretation of the seventy one little Tables or Inscriptions written in the Latine tongue, dispersed throughout the whole Mappe, expressing therein such things as he thought most meet to be noted in divers parts of the world, all which Tables or Inscriptions, I have here also set downe in our mother tongue. And although that to the foresaid Tables or Inscriptions Plancius hath attributed certaine numbers for the more easie finding out of the said Inscriptions, yet not easie enough by reason that one selfe number is set downe in divers Tables: and therefore to the intent that you might the more readily find out every Table that is proper to the matter whereof it maketh mention, I have here following joyned to the number of every such Table his proper Longitude and Latitude, which with your Compasse you may quickly finde, and more certainly, than by his numbers, if you remember the order thereof set downe in my Treatise of universall Maps.

But now I will declare the contents of the foresaid sixteene pages in order as followeth.

The

The title of the firſt page is thus:

A brieſe declaration of the diviſion, forme or ſhape, and of the particularites of the world.

The Contents of the firſt page.



That the earth and the water do make both together one round body, which the Coſmographers do inviron with five Circles, that is, the Equinoctiall, the two Tropiques, and the two Polar Circles, and thereby do divide the world into five Zones, two cold, two temperate, and one extreame hot: and though that the ancient Geographers do affirme that three of thoſe Zones were unhabitable, the one for extremity of heat, and the other two for extremity of cold, yet within theſe hundred yéares laſt paſt it is knowne be good experience, that thoſe three Zones are well inhabited, as the manyfold Countries therein placed, and greatly replenished with people of ſundry languages, do well teſtifie, of all which things I have written at large in my Spheare. And therefore I make this page the ſhorter.

The Contents of the ſecond Page.



To know the true ſituation of the Provinces and places contained in this Pappe, it is neceſſary firſt to know their Longitudes and Latitudes. The degrées of Latitude or of the elevation of the Pole, which is all one thing, are counted from the Equinoctiall to either Pole, which is 90 degrées, and the degrées of Longitude are counted upon the Equinoctiall from the Iles of Cipo Verde towards the Eaſt, and ſo round about the earth untill you come to the number of 360 degrées. The Provinces and Townes that are ſituated under

under one degrée of Longitude, haue at one self time like houres of the day, but those that are situate under diuers degrées of Longitude, do differ in number of houres, for when it is in one Towne noontide, it is in another Towne, that is distant from thence towards the East 30 degrées, two of the cloche in the afternoone, and so consequently, for euery 15 degrées of distance they differ an houre. Likewise they that dwell under one selfe degrée of Latitude haue equall quantity of dayes and nights, but yet so as they which dwell on the South side of the Equinoctiall haue the shortest day when we haue the longest, and haue Winter when we haue Summer. But those that are situate under diuers degrées of Latitude, haue inequality of dayes and nights, for the nigher that any place is situate towards any of the Poles, the more houres the longest day of the yéere in that place containeth, but those that dwell right under the Equinoctiall haue alwayes their dayes and nights of like quantity. And I vnderstand here by the day, the space betwixt the Sun rise, and the Sunne set, and you shall finde the quantity of the longest day of the yéere in euery degrée of Latitude set downe in the Northeast part of this Card. As for example, to those that haue 30 degrées of Latitude, the longest day is 13 houres, 57′, & so the nigher that you go to the Pole the longer is the day, insomuch as to those that dwel right under the Pole, the yéere is but a day and a night, that is to say, they haue 6 months day, and 6 months night. Moreouer the Geographers do diuide the earth into 9 climes, for to distinguish thereby the Prouinces and Regions by the quantity of the longest day, the middlemost Parallel of euery clime increasing by halfe an houre. And you haue to consider that the degrées of Latitude are in al places of like bignes, euery degrée containing 15 Alman leagues, or 60 Italian miles, but the degrées of Longitude proceeding from the Equinoctiall towards any of the two Poles are unequall, that is to say, euery one containing fewer leagues or miles than other, but the degrées of the Equinoctiall it selfe are equall to the degrées of Latitude, euery one containing 15 German leagues, or 60 Italian miles, as you may plainly see in the Table set downe in the Northeast part of this Map. And you haue

to note, that one Almaine league doth containe foure Italian miles, and we have described the degrée of Longitude in the Southwest part of this Card by the houres of the ships way, every one decreasing lesse than other from the Equinoctiall to the Pole, wherby you may conceive, that two ships being right under the Equinoctiall 150 degrées distant one from another, and are to saile with like gate towards the North Pole, when they shall come to the 60 degrée of Latitude, their distance shall be no more but 75 leagues. And the further they go towards the Pole the lesse distant they shall be one from another, insomuch as when they be right under the Pole it self, they shal both mæt, as you may sée in the two round figures containing the description of the earth, and set downe in the two nether corners of the Map. This matter is to be considered of the Marriners, that they may thereby the better perceive the imperfections of their sea Cards. Moreover, in the second page Plancius setteth downe the division of the earth, aswell according to the ancient as moderne Geographers, making first three generall continents or firme lands, wherof the first is so much as was knowne to Ptolomy, and to the ancient Astronomers, as Europe, Affrique, and Asia: the second continent is called America; and the third continent is the South part of the world, not yet fully discovered, called of Plancius, Magellanica; and he divideth the second continent called America into three parts, that is, Mexicana, Peruana, and Magellanica, and by adding those three parts to Europe, Affrique, and Asia, he divideth the earth into six parts, and first he setteth downe the description of Europe together with her bounds or limits, and then the commodities thereof, as followeth.

Of Europe.

EVrope is farre lesse than all the rest, and yet excédeth all other in nobleneſſe, in magnificence, in multitude of people, in might, puissance, and renowne, the which in times past hath commanded both Asia and Affrique as Quéene, by reason of the Monarches of the Grécks and of the Romans, and at this day is of great force by the power of the Turks and Muscovites.

vites. Moreover it commandeth many Provinces in Mexicana and Peruana by the power of the Spaniards and Portugals, and of other Christian Princes.

Europe is severed from Asia, and Affrique by the sea Mediterraneum, and by the sea called Mare major, and by the Pariſh or sea called Palus Meotis, and by the flouds Tanais and Dwina. The chiefest Provinces of Europe are these, Almanie, Italy, France, Spaine, Denmarke, Norway, Swethland, Muscovia, Polonia, Hungaria, Sclavonia and Greece. The chiefest Ilands of Europe are these, England with Scotland, Ireland, Sardinia, Corsica, Cicilia, Candia, Nigro Ponte sometime called Euboia, and Stalimine, sometime called Lemnos. And in this second page he setteth downe also the description of Almanie thus:

Almanie is reputed to be the greatest Province in all Europe, and is situated in the middest thereof, which is bounded on the East with Polonia and Hungaria; on the South with Dalmacia, and Italia; on the West with France; on the North with the North Sea, and the Sea called Mare Balticum. The Inhabitants of this Countrey warred in old time with the Romans for their liberty, and since many hundred yeares past it hath holden the imperiall Scepter. About the time of Christ his birth, it was a rude Countrey, as Cornelius Tacitus saith, full of Wood, Bulhes, and Pariſhes, but at this day it is so adorned with great magnificent Townes and well fortified, and is furnished with such a number of Castles, and Villages, and with such a number of people, and with such politique government, as it is to be compared to any Province whatsoever in all the world. The soyle thereof is very fruitfull both for Corne and wine, and hath many navigable flouds stored with plenty of fish. It hath most excellent fountaines and hot Bathes, great mines of Gold and Silver, Copper, Tinne, Lead, and Iron. The Inhabitants do exercise as well now as they have done in times past the Art Military, and it hath many learned men very skilful in all sciences, and in mechanicall Arts: they were the inventers of Artillery, of Gunpowder, and of the noble Art of Printing, and of making artificiall Dials and Horologies.

The chiefe merchandyes that are transported out of Almanie into other Countries are these, Gold, Silver, Copper, Tinne, Lead, Vitrioll, Allum, Quicksilver, Colours of divers sorts, Slates to cover houses, Wheat, Wine, Fish, Mollencloth, Linnen cloth, Bombasine, Fustian, Suile, Armour, all sorts of workes made of Iron or Brasse, and other merceries.

The Contents of the third Page.

In the third page he describeth the 17 Provinces of the Low Countries; also Italy, France, Spaine, and Denmarke, as followeth.

The 17 Provinces of the Low Countries are counted a part of Almanie, by reason that the most part of the inhabitants have aswell their original as their language from the Almaines. But those of Arroys, of Henough, Namures, and part of the Inhabitants of Brabant, Flanders, Lymburgh, and Liezenburgh do speake the French tongue. These Provinces are situate partly within the ancient limits of Almaine, that is to say, beyond the Oriental part of the flood Rhenus, and partly in Gallia Belgica, as also are the Provinces of 4 of the Princes Electors, and many other Provinces of the Empire. In these Provinces are many navigable floods, and rich in fish, namely the Rhene, Mosella, Mosa, and the Escaut, and there is great abundance of all sorts of Corne and Cattel meet for mans use, there is also a number of great Cities, rich, mighty, and well peopled, also of Fortresses well fortified, faire Villages, but chiefly of brave and commodious Ports and Havens, and an incredible number of ships, and the continuall wars that they have had and have at this day, do witnesse to all the world their great force, might and riches. The inhabitants in time of the Romane Monarchie were, and also are at this present greatly renowned for their skill in the Art Military, and besides that, they are most excellent and industrious in all sciences and mechanicall Arts, and they have a great number of Mariners

and

and Pilots well practised in the Art of Nabigation, and to these Prouinces is attributed the inuention of the Mariners Compasse, according to the opinion of many learned men, which truly is one of the noblest inuentions that euer was found out since the world beganne. In the Towne of Burghelle was inuented the Art of Painting with colours tempered with Oyle.

The Prouinces of Belgia do send vnto other Prouinces all sorts of Clothes made of Woolle and Flax, Linnen cloth of Cambrie, Scarlets enterlaced with Gold, Siluer, and Silke, Taffaties, Bozattas, Grograines, single Mutten, Sales of Leyden and Howlcot Worsteds, and halfe Worsteds, Fustianapes of Vellures, and of Woll, Bayes, Silke, Parchment lace, Sarcenet and Inkle, all manner of twisted thread, Silke ready dresse, purified Sugar, Buffe, Shamppes, Striped Ranskines, painted Pictures, Belts, Armour, Cables, Ropes, and other munitions belonging to Ships, Knives, Pinnes, and all sorts of Mercery or Haberdash ware, and Fish dried and salted.

ITaly being the mother of eloquence and of all Latine erudition, doth extend it selfe like an arme towards the Southeast, lying betwixt the Tuscane sea, & the gulfe of Venice, & is bounded on the West part with France, & on the North part with Almanie, being seperated from the said two Prouinces by the Mt. Varo & the Alpes, and all the rest is enbironed with the sea. At the time of the Nativity of Christ, and since, she most flourished, being adorned with the fourth Monarchie, and with the most mighty Towne of Rome, which at that time was Queene of many Prouinces of Europe, Asia, and Affrique, which City in the time of the Emperour Vespasian had in circuit 13. Italian miles and 200 paces, as Plinie writeth in his third booke and fift chapter: Clavius Vopiscus reciteth that this Towne was enlarged by the Emperour Aurelius to 30 Italian miles, which is 10 houres of way or gate, allowing three miles for an houre. This Prouince hath brought forth, as it doth at this present, Inhabitants of great industry and wit, and it containeth many noble Cities

and of great renowme as Rome, which hath bene sometime the head of the world, Venice the rich, Ravenna the ancient, Naples the gentle, Florence the beautifull, Genua the proud, and Millaine the great. In a Towne called Annalphe situate upon the Sea, betwixt Naples and Salerno, the Mariners Compasse was invented in the yeare 1300, according to the opinion of some, by one Iohn Goia, citizen of the same Towne: notwithstanding Iohn Gorop Becanus doth attribute that invention to Flanders, which seemeth the more likely, for so much as all the Pilots and Mariners of France and Spaine, and other Places, do name the 32 winds or Rumbs of the Compasse by the Belgick names. The chiefe Merchandizes that are sent out of Italy into other Countries are these, Rice, Silke, Velvet, Satten, Taffaties, fine peeces of Linnen, Grograines, Rash, Stamin, Bombasins, Fustians, Felts to make riding cloaks, plenty of rich armour, Wiar of Gold and Silver, Allum, Galles, drinking glasses, and looking glasses of Venice.

FRance hath bin alwayes esteemed to be the chiefest Realme of all Europe, whose soyle is most fertile, and bringeth forth all kind of Graine, and every other thing that is necessary for mans sustenance: there is great store of wine, and great plenty thereof is distributed to other Provinces nigh adioyning. The Province doth abound in oyle Olive, and in Corall, and in many other noble fruits. In France are many great Townes well walled, as Paris, Roan, Amiens, Orliens, Toures, Nants, Poicters, Burghes, Tholous, Lyon, Narbona, and Mercelles. It hath 15 Archbishopricks, and 108 Bishopricks, and a great number of Townes and Villages, and 132000 Parishes. it is greatly peopled, and hath not such desarts or heaths as are in other Provinces of Europe. The French men have bene, and are at this present renowned in the Art Military, and there be many learned men in all faculties and Sciences.

The chiefe Merchandizes that are carried out of France into other Provinces are these, Wheat, Rie, Beeves, Hogges, Swine, and other Cattell, Salt, Wines, white Oliue, Chesnuts, Almonds, Prunes, Corall, Dyars woade, Clothes,

Clothes, Linnen, Canvaſſe, and Skinnes.

SPaine is inuironed round about with the Sea, ſaving that on one ſide it is ſeparated from France by the Mountaines Perenei. This Country was ſometime diuided into three Prouinces or Kingdomes, that is Tarraconenſis, Lufitania, and Betica, but now it is ſubdiuided into many Realmes, that is to ſay, Caſtilia, Aragon, Portugall, Gallicea, Lyon, Navarra, Toledo, Valencia, Murcia, Granado, Gorda, and Algarbia, the which Realmes if they had beene reduced to one body of a Realme as France is, and as they be at this houre ſubiect to one only King and Lord, it ſhould be without doubt one of the moſt mighty and puiſſant Kingdomes of Europe. The Inhabitants of Spaine haue beene and are at this preſent much renowned in the Art Military, and in feats of warre, and it hath brought forth in times paſt many great Clearkes, as Seneca, Quintilian, Lucan, and Martial, and in our time it had Iohannes Ludouicus Viues, Iohannes Oſorius, and Benedictus Arias Montanus. The Prouinces of Spaine are become very rich and mighty, by reaſon of their Nauigation into America, Africa, Arabia, Perſia, India, the Iles Moluccas and China, in which Prouinces (China excepted) the King of Spaine poſſeſſeth many Countries, that be rich and of great power, and many Townes and Fortreſſes in a manner round about the earth.

The chiefe Merchandizes that growe in Spaine, and are carried into other countries are theſe, Wines, Oyles, Rice, all ſorts of fruits of Spaine, Limoons, Silke, great quantity of Cattell, Lamb-skins, Cork, Roſin, Steele, Iron and Armour.

DEnmarke and Norway are very great Regions, and are as large as the countries of Almanie bordering vpon Almanie towards the South, they extend towards the North to 71 degrees, 30', of North Latitude, and towards the Eaſt they border vpon Swethland, and on the Weſt and North ſide they are inuironed with the Sea. Theſe two Realmes are at this day vnder the gouernment of one only King, who alſo is Lord of Iſland, and of the Iles of Fero, Hitland, and Gothland.

Iuthland

Iuthland was sometimes the habitation of the Cimbres, who in times past made cruell warres against the Romans.

The merchandizes sent from the two forelaid Realmes into other Provinces are these, Oxen, Barly, Malt, Stockfish, Tallow, Furres and Filbirds, hides of Oxen, and Buck skins, Masts for ships, planks and the tops of Mastes, Sailes, fire wood to burne, Pitch and Tarre, Brimstone, and such other things.

The contents of the fourth page, wherein he describeth Swethland, Polonia, Hungaria, Sclavonia, Greece, England *and* Scotland, *as followeth.*

Swethland is a great and mighty Realme, bordering towards the East upon Russia, and towards the South upon the East Sea, called Mare Balticum, dividing Swethland from Almanie and Pomerania, and towards the West upon Norway and Denmarke, and towards the North upon Finmarke. Stockholme is the Metropolitane City in this Realme, wherein the King keepeth his Court. From this Realm is transported into other Provinces these Merchandizes, that is to say, Copper, Iron, Lead, costly Furres, hides or skins of Elkes, of Oxen, of Bucks, of Goates, Tallow, Tarre, Barley, Malt, Nuts, and Filbirds, and such like.

The description of Muscovia which should follow next, is set downe in the third Table of inscription, which standeth in the very front of the Table, written in Latine, the interpretation whereof hereafter followeth in his place.

The kingdome of Polonia containeth Lituania, Podolia, the lesser Russia, Volhinia, Massovia, Samogitia, Prussia, and in a manner all Livonia, which two last Provinces do belong not long since to Almania. Polonia is bounded on the East with Muscovia, and with the Tartaries perocopiques, and on the South with Moldavia, and Hungaria, and towards the West with Almania, and towards the North with the sea Balticque, and Muscovia.

The

The chiefe Merchandizes that go out of this Realme into other Prouinces are these, Wheat, Rie, & other graine, Spruse or Dansk Beere, yellow Amber, Wax, Hony, a certaine drink made of Hony which we call Meade, hides of Oxen dryed and salted, Flax, Hemp, Pitch, and Tarre, Ashes, Clavelloes, woad, Waxier, and of Cuvelier, and other such like Merchandizes.

HVngary is a very fruitfull Realme, rich and mighty, and it is bounded on the East with Moldavia, and Valachia, and on the South with Bosnia and Croatia, and on the West with Almania, and on the North with Polonia. It hath many navigable Rivers, wherein are great store of fish, that is to say, Danubius, Dravus, Savus, and Tibiscus. The chiefe Townes are these, Buda, Gran, Weissenburgh, Rab, Prezburgh, Agria, Colocza and Belgrada. The Inhabitants of this Country are warlike and hardy, and have beene long time heretofore a most faithfull Champion and bulwarke to all Christendome, but in the end by reason of their ciuill warres, the better part of them have beene subdued in our time, and are made most miserable slaues to the Turke.

The Merchandizes which go out of Hungary into other Prouinces are these, Gold, Siluer, Copper, and diuers sorts of Colours, Salt, Wine, Wheat, Beeues, and fresh Fish of the River salted.

SClavonie is bounded on the East side with Bulgaria, and Greece, and on the South side with the Gulfe of Venice, and on the West, with the North part of Italy, and on the North side with Almanie and Hungarie. This Region containeth many particular Prouinces, as Liburnia, Croatia, Bosna, and Dalmatia, the chiefe Townes whereof are these, Ragusa, Sabioncha, and Zara. Sclavonie at this time is diuided into many Iurisdictions, for one great part thereof is subiect to the Turke, another part to the Emperour of Almanie, and the rest situated upon the Sea Coast is subiect to the Seniorie of Venice. At this day there is no tongue (the Arabic tongue excepted) that is vnderstood further than the Sclavonie tongue, for as it

is

is the vulgar tongue of Sclavonie, so is it familiar to them of Histria, Bohemia, Moravia, Silesia, Polonia, and to the large Provinces of the great Duke of Muscovia, Circassia, Periboka, Georgiana, Mengrelia, Moldavia, Valachia, Bulgaria, Russia, Servia, Albania, and to part of Hungary, it is also familiar in the Court of the great Turke, and among his Souldiers that serve in Asia and Affrique.

GReece, sometime the mother of all Science and erudition, is on the East, South, & West side invironed with the sea, but on the North side it is bounded with Servia & Bulgaria. It hath in times past valiantly fought with and beaten the Monarchie of Persia for the liberty of their Country, and finally by Alexander the Great hath triumphed over the same, and thereby erected the third Monarchie, by meanes whereof it came to passe that the Greeke tongue was made common throughout Asia, Syria, and Egypt, untill such time as the Saracens and the great Turke did corrupt and change the same. The Emperours did rule in Greece from the time of Constantine the great unto the yere 1452, in which yeare Mahomet the great Turk forced the Town of Constantinople, and abolished the Empire of Greece, in such sort as ever since this magnificent and strong imperiall Town of the Christians, hath been the seat of the Emperor of Turkie, and all the Country made slaves to the Mahometans.

The chiefe Merchandizes that come from this Country to other Provinces are these, Gold, Silver, Copper, Vitriol, divers sorts of Colours, Wines, Oyle, Velvets, Damasks, Grograines, Turquesques and Wood.

ENgland together with Scotland making both but one Iland is the greatest and mightiest of all Europe. And England is environed on all sides with the Sea, saving on the North side, which bordereth upon Scotland. The Ayre according to the situation is indifferent temperate, for though it be more Northward than Flanders, yet it is not subiect to such hard frosts and cold winters. The soyle is very fruitfull, bringeth forth great plenty of Wheat and of other Corne, it hath great plenty of fruit-

fruit-trées, & there be many large and faire woods, sweet fountaines, floods and rivers full of fish, and a number of good havens, also it hath many rich Mines, as of Gold, Silver, Lead, Iron, and chiefly of fine Tinne, wherefore it may be worthily counted amongst the most puissant and richest Ilands of the world. This Iland nourisheth also a great number of cattell meet for mans use, and chiefly of sheep, which yeldeth fine and good Woll, in which, partly consisteth the profit and riches of the Country, in such sort, as the Golden Fleece ought to have bin sought for in this Iland, and not at Colchos. The Inhabitants most commonly are tall of stature, beautifull, and white of visage, courageous and meet for war, also they are ingenious and studious in the Art of Navigation, insomuch as in these dayes they have traffique into very farre Countries, as into Greece, Natolia, Syria, Egypt, Barbaria, Muscovia, and into many other Provinces. London being situated upon the Thames is the Metropolitan and chiefe Towne of this Realme, and the Staple of the trade of Merchandizes, and the Court Royall: but Cambridge and Oxford are Universities.

The Merchandizes sent from England into other Provinces are these, Woad Clothes, Carseyes, Stamines, Bayes, Sayes, Saffron, Tin, Lead, Wheat, Barley, Malt, Beere, Red Herring, Sea-cole, and Wood.

SCotland is the North part of this Iland, and is likewise invironed round about with the Sea, saving on that side with which it bordereth upon England. This Country is not so fruitfull as England, notwithstanding it is sufficiently provided of all things that is needfull for mans nutriment, it is watered with divers armes of the Sea, and is indued with many mountaines ful of graste, which serveth to feed their cattel. Edenburgh is the Metropolitan of this Realme, wherein the King keepeth his Court. The Scottishmen are good Souldiers, which can endure scarcity and the iniuries of the Ayre, and are very desirous to winne honour. The Inhabitants of the South part thereof do speake the English tongue, but those of the North, and those of the Iles Hebrides do use the Irish tongue, and those of the

Orcades

Oracles do use their owne tongues.

The Merchandizes which Scotland sendeth to other Countryes are these, course Clothes, Karseys, Stamins, Freses, Mooll, Barly, Malt, Fish, Hides, Leaden Ore, and Smiths Cole.

The Contents of the fift page.

IN this Page he describeth Ireland, the Iles Azores, Corsica, Sardinia, Sicilia, Candia, Nigroponte, Sclauonie, all which Ilands to belong to Europe; and in the later end of this page he beginneth to describe Asia.

IReland is nigh unto England and Scotland, and is very rich in meadow ground, and hath great plenty of Cattell as well tame as wilde, and Fish as well of the Sea, as of fresh Rivers, and great quantity of Fowle and Birds; but it hath scarcity of Corne by reason of the great moystnesse of the Ayre. This Ile is free from all venemous beasts; the Inhabitants are wilde people, great and strong, swift in running, and by little and little they war every day tamer than other, under the government of the English men.

THE Iles of Azores are called of the Flemish Pilots and Mariners, the Flemish Iles, because those of Bruges were the first that discovered those Ilands. And albeit that at this present the inhabitants therof are Portugals, there is yet a remnant of Flemish Families, as of the Bruines, of the Vitrickes, and others. These Iles are fruitfull, and be 9 in number, that is to say, the Iles of S. Marie, S. Michael, Tercera, Graciosa, S. George, Pico, Fayal, Flores, and Coruo.

Tercera amongst all the rest is the strongest, and bringeth forth Dyers Woad. The Ile of S. Michael bringeth forth Sugar, and great abundance of Dyers Woad.

Corsica

CORfica is situate in the Sea Mediterraneum, and bringeth forth most excellent Wines, rough Horses, and great hunting Dogges: and this Ile is governed by the Genueses.

SArdinia is a very fruitfull Ile, and chiefly of Wheat, which is transported from thence into Italy and into Spaine. Likewise it hath very good Wine, both red and white, and very good Salt, it hath also certaine Mines of Silver, but not of so profitable yeeld as in times past. The inhabitants are strong, and are able to endure great labour and travell, in great Townes they speake the Spanish tongue of Aragon, but in small Townes they speake the vulgar tongue of the Ile.

SIcilia hath beene alwayes famous, and is called of Diodorus the Paragon of Iles, also the Greeks and Latines have greatly celebrated this Ile in their writings. This Iland hath great abundance of Wheat and of all other Graine: Also of Wine, Sugar, Wax, Honey, Saffron, Silke, and of al things else appertaining to the use of man. Wherefore this Ile, together with Egypt, was sometime called the Grange of the Romans. In this Iland is the hill Ætna, which alwayes burneth. And in the Sea of Sicil nigh unto Drepano, as Plinie writeth in his 32 Booke and second Chapter, there groweth very faire red Coral, in shape like to such a tree or bush as is here figured, which while it is under the water is green and tender, but so soone as it commeth into the Ayre, it waxeth hard like a stone, and is red. there is found thereof also nigh unto the Sea Coast of Province, also in Italy nigh unto Monte alto, and to Naples, likewise in the red Sea, and in the Gulfe of Persia, and there be three sorts of Corall, that is, red, black, and white.

CAndia, sometime called Creta, was in old time enriched with the famous Labyrinth, and with a hundred Cities, it had also a great number of good ships and expert Pilots. This Ile together with others, as the Ile of Zante, Cephalonia, Corsue, and divers others, be at this present governed by the Senat of Venice.

The

The Merchandizes tranſported out of Candia into other Prouinces are theſe, noble Wines, as Malmſey, Muſkadine, Corants, Graine of Scarlet, Sugar, Chryſtall of the Mountaine, Cotton, and Buck-skins.

NIgro-ponte, ſometime called Euboia, is a very fruitful Ile in Wheat, Oyle, and Wine.

STalimine ſometime called Lemnos, is an Ile which hath abundance of Wheat, and moſt excellent Wines. In this Ile they digge out in the month of Auguſt a certain medicinable Earth, called of the Phyſitians, Terra ſigillata. There be many other Iles beſides theſe in Europe, as the Iles of Denmarke, the Iles of Zeland in Flanders, the Ile Frumentera, Iuica, Majorica and Minorica, and a number of Iles that are in Sclavonie and Greece.

ASia is ſeperated from Europe, by the flouds Tanais and Dwina, and from Affrique by the narrow part of Land, which is nigh to Egypt, betwixt the Mediterran Sea, and the red Sea. Aſia far exceedeth in greatneſſe both Europe, Affrique, and Peruana. and alſo in riches, as in pearles of great price, precious ſtones, and ſpices it exceedeth all the other Countries of the World.

This Region hath beene alwayes renowned by the firſt and ſecond Monarchie of the World, obtained by the Syrians and the Perſians, as alſo it is at this day by the mighty Princes of China, and of Perſia, and by the puiſſance of the Tartarians.

In this part of the world man was Created of God, placed in Paradiſe, ſeduced by Sathan, and redeemed by our Saviour Jeſus Chriſt: and in this Region were done in a manner, al the Hiſtories and Acts mentioned in the old Teſtament, and a great part of thoſe in the new Teſtament. The moſt celebrated Prouinces of Aſia are thoſe that belong to the great Duke of Muſcovia, alſo Tartaria and China, the rich Prouince of India, as Guzarette, Coraſan, Sigiſtan, Chirmania, Parthia, Perſia, Media, Aſſyria, Armenia, Natolia, Syria, and Arabia. The princi-

pall

pall Iles of Asia, are these, Iapan, Luconia, Mendanao, Borneo, Sumatra, Ceiland, and Cypres, for as for the Iles of Gilolo, Moluccas, Banda and Celebes, they belong to that part of the World which is called Magellanica.

The most mighty Potentates of Asia are these, the King of China, the King of Persia, the great Turke, and the Emperour of Russia, otherwise called the great Duke of Muscovia, according to which Seniories all Asia is divided into six parts, that is to say, the Asiaticall Provinces, belonging to the great Duke of Muscovia 1. Tartaria 2. China 3. the Indies 4. the Provinces of the King of Persia 5. and those of the great Turke 6. And as touching the Asiaticall Provinces of the Emperour of Russia, and of the Provinces of Tartaria, we shall make mention thereof hereafter, when we come to translate the Tables or Inscriptions written in Latine, marked with the numbers 3. and 4.

The Contents of the sixth page, wherein he describeth China, and the plant of Pepper there growing, with the shape thereof.

CHina or Sina is the third part of Asia, sometime called of Ptolomy, Sinarum Regio, which on the East side is environed with the Sea called of the Ancient Geographers Oceanus Siricus, or the East Ocean, and on the West it is bounded with the Indies and with Brumas, and on the North with Tartaria. This country is for many causes esteemed to bee the most ample, the Richest, and most Mighty Realme of all the world, for it extendeth from the 18 degree to the 55 degree of North Latitude, and it containeth in Longitude 450 leagues of Almaine, and it is divided into 15 great Provinces or Realmes, that is, Quincii, otherwise called Paquin, Xanton, Xiancii, Sancii, Suchuan, Honao, Nanquii, Chequiam, Foquiem, Cantam, Quancii, Suinam, or Huinam, Quiecheu, Fuquam, or Hucquam, and Quiancii. This Realme is adorned with many Navigable Floods, and full of Fish, it is very fruitfull

full, and bringeth forth great abundance of all kind of Graine, and amongst the rest of Rice, every yeare three or foure times in a yeare. It hath goodly woods and forrests, wherein do keepe a number of wild Boares, Foxes, Hares, Conies, Sables, and Martins. The mountaines are ful of grasse, serving to feed infinite heards or troops of Cattel, both great and smal. There be also many mines of precious stones, of Gold, Silver, Copper, Steele, and Iron, and a great number of Pearles, but not very round, and great abundance of silke. The townes there are very great, fortified, and well peopled, which is easily knowne by the greatnesse of Cantan, which is one of the least Metropolitan Cities of the Realme, and yet it containeth in circuit 12 Italian miles, & 350 Geometricall paces, which is more than foure houres journey, not reckoning the suburbs, which are very large and full of people. The principall Metropolitan Towne where the King keepeth his Court, is named Pasquine or Suntie, that is to say in their tongue, the Celestiall or Heavenly City: touching the greatnesse whereof, the Portugals and the Castilians do write many incredible things, and according to the opinion of many, it is the selfe same towne which Marcus Paulus Venetus calleth Quinsay, as that which hath divers names in divers languages. The like may be said of a Towne in Flanders, which the French men call Lile, the Flemings Russill, and in Latine it is called Insule. In these Provinces be many good Ports and Havens upon the Sea, and a great number of ships, by reason whereof the Inhabitants are moved to say, that amongst them, there are as many that dwell in ships upon the Sea, as be of them that dwell in houses upon the Land, and that their King might easily make a bridge to passe from China to the Towne of Malaccha, which is distant from them 300 Almaine leagues. But above all there is one thing worthy of admiration, and that is a wall which hath in length 400 Spanish leagues, which the King of China caused to be built, to defend the Country against the invasion of the Tartarians, of which thing if the ancient men had had any knowledge, they would have counted this worke among the seven wonders of the world. The Inhabitants are men of spirit, and given to labour. There was

also

also invented by them such a kind of writing, that every man of what nation soever he were, being somewhat exercised therein might pronounce in his mother tongue, even as it were Ciphered. They invented also certaine Chariots, wherein they might saile by the Wind upon plaine ground, as they do in ships upon the Sea: there are also men amongst them that are well learned in all Sciences, and especially in Architecture, wherein they excell all others. Moreover they are great lovers of Learning, & those that do excell others therein, are promoted to the most honorable estates: they have good municipal lawes, and will suffer no Stewes, and they forbid that any man shall marry any woman with whom he hath lived before in adultery, and they greivously punish all offences, and do forbid idlenesse as the mother of many evils, yea they do constraine blind men to get their living, by turning with their hand milles made to grinde Corne, or any other things, and in their wars against the Tartarians, they get the victory more by fine pollicie and stratagems, and by multitude of people, than by prowesse or feates of Armes. The Portugals do report that the King bringeth to the field 3000000 footmen, and 200000 Horsemen. Now as touching their Religion, they be Paynims and Superstitious Idolaters, saving that there are in many places some Christians, as Marcus Paulus Venetus testifieth.

The chiefest Merchandizes transported out of China into other Provinces are these, Gold, precious stones, Pearles, Muske, Rubarbe, the medicinable root, China Purslaine, abundance of Silke, Sugar, Rice, and all sorts of Graine. The plant of Pepper is sowne at the roots of other trées, but specially at the root of that Indian trée which is called Faufell, and at the root of the Date trée, to the tops whereof it climeth up, much like as Ivie doth upon a trée, or like to that which is called in Latine Clematis, in English Perwinkle, which will winde about every hearbe that groweth nigh it, the root is but small, and his leaves thin, like unto Citron leaves, but somewhat lesse, and sharpe pointed, grene and byting in the taste, the graines do grow nigh one to another, like the long Grape, and are alwayes grén untill they be through ripe and drie. There be two kinds therof,

that is, white and black, but the plants of both are much like to our white and red Vines. Pepper groweth in places neere the Sea side of Malacha, and in the Iles of Sunda and Cuda, situated nigh unto the Ile Iava major, but the best kind of Pepper most plentifully groweth in the Province of Malabar, betwixt the Cape Comori and the Cape Canonar, but long Pepper is found in the Realme of Bengala, and is another kind of Plant, altogether unlike to this.

The Contents of the seventh Page, wherein he first describeth the red figge tree of India, and setteth downe the shape thereof; then he describeth the East Indies; and last of all he sheweth the nature of the Elephant, whose shape he setteth downe in the same Page.

THe Indian fig-tree groweth round about Goa, the body therof is high and great, and extending his branches in a round forme, which like yellow or golden fillets do stope downe towards the Earth, so soon as it toucheth the Earth, it bringeth forth a new generation of trees which differeth nothing at all from the mother but only in thicknesse, des Souches, and the branches of those do bring forth new trees in like manner, insomuch as the mother with her off-spring will in short time spread as much ground as containeth an Italian mile in circuit, the fruits are small Figges, and red as blood, as well without as within.

India tooke his name from the Flood Indus, which bordereth towards the East upon the Realme of China, and towards the South upon the great Ocean of India, and towards the West upon the Sea of Arabia, and also upon the Flood Indus, and towards the North upon the Sea Mare Euxinum, or Mare major, and upon Bramas.

This Country is judged at this day, as it hath beene long since, to be the Noblest and Richest Country in all the whole World, and it is divided by the Flood Ganges into two parts, whereof

whereof the West part is called Indostan, or India intra Gangem, and the East part is called India extra Gangem, and it containeth many Provinces and Realmes, as Cambaiar, Delli, Decan, Bisnagar, Malabar, Narsingar, Orixa, Bengala, Sanga, Mogores, Tipura, Gourous, Ava, Pegua, Aurea, Chersonesus, Sina, Camboia, and Campaa. These Provinces are wattered with a number of Goodly Rivers amongst the which Indus and Ganges are the most renowned Rivers of the World. Moreover, these Provinces do abound in all things that may grow either within the Earth or upon the Earth, except it be Copper and Lead, as Plinie affirmeth, also all manner of Plants that grow there are very great, brave and excellent good. India exceedeth all other Countries in precious stones and in spices, furnishing therewith almost all the World. It hath many rich mines of Gold, and great store of faire pearle, also great multitude of all manner of Cattel, Horses only excepted, which are brought thither out of Persia and Arabia. It is not long since that Callicute was the chiefe Towne of Merchandize in India, but at this present Goa is the chiefe: there is also great trafique used at Dio, at Cananor, at Cochin, at Bengala, at Pegu, at Malacha, and at Sian.

Of the Elephant.

THE Elephant amongst all other foure footed beasts is the greatest save the Dragon and the Crocodyle, he is very ingenious, insomuch as it is incredible that which the Ancient men write of him, and also the moderne, which have sought more diligently to know his nature and disposition, he is of force incredible, and meet to draw ships and boats both out of the water and into the water, and to draw Artillery and Ordinance, he is also meet for the warre, his teeth that shoot out of his mouth are Ivorie, there is great number of them found in the Indies, and in Affrique, but the greatest and fittest for war are found in the Ile of Ceiland, nigh to Calicute.

The Contents of the eighth page, in which he deſcribeth the Beaſt called Rhinoceros, and ſetteth downe his ſhape, and he deſcribeth the Synamon tree, ſhewing the ſhape of the trunk and of the leafe therof, and alſo the Musk Cat with her ſhape, and in the later end of the page he deſcribeth the Realme of Perſia.

THe beaſt called Rhinoceros, is as long & as large as the Elephant, but not ſo high, for his legs are ſhorter, he is armed not like a Tortoiſe (as Plinie ſaith) for that is covered all over with one ſhel, whereas this beaſt is armed with manifold ſtrong, hard, and thick ſkales, which are yellow and ſpotted with purple, hee hath a ſtrong horne or bone upon his noſe, wherof he taketh his name, and he hath another little horne upon his back, and he is a great enemy by nature unto the Elephant, he is found in the Realmes of Cambria and of Bengala.

The Synamon Tree.

THe Synamon trée, is as big as the Olive trée, the branches and grafts whereof are very right, his leaves in colour are like to thoſe of the Laurel trée, but in ſhape like to thoſe of the Citron, his Flowers are white, and the fruits therof are black & round, like a hazel Nut, the Synamon it ſelfe is no other but the bark of the ſaid trée, which groweth in the Province of Malabar, and in the Iles of Iava and Mindanao, but the beſt is found in the Ile of Ceiland.

The Musk Cat.

THe Musk Cat, is like in ſhape to a common Cat, but ſhe is greater than either Cat or Fox, her muzzell is ſomwhat long and armed with harp teeth, and with harſh haire, which haires, (being angry) ſhe will ſet up as a Swine doth his brſtles, ſhe is in colour like a Wolfe, but that ſhe is ſpotted with

black

black spots, the nether part of her muzzell and the hayres of her beard are white, her feet are black, her flankes are whitish and do wax whiter and whiter towards her belly, and next to her Genitories she hath a little bag like to a bladder or purse, into the which doth fall the precious grease or humour, which they call Civet and Zibeth, which Civet is gathered out from thence with a spoone, if she be in mans keeping, but when shee is abroad and at her owne liberty, her bag being full, shee will void that Civet of her selfe, and it will yeeld such a sweet savour, as all they that saile by that Coast may smell it a far off, as I have heard. These Musk Cats are brought from the Realmes of Pegu and Tartassary.

The description of Persia.

As those in Persia have enjoyed in times past the second Monarchie of the world, so at this present they bee still very mighty, for the King of Persia is one of the greatest Potentates in the whole world, as he which commandeth all the great Provinces that do border towards the East upon the flood Indus, and towards the South upon the Sea called Mare Caspium, and upon the flood Oxo, within which limits are comprehended all the greatest Realmes and Lands which the ancient Geographers were wont to call by these names, Assyria, Media, Susiana, Persia, Parthia, Hircania, Margiana, Bactriana, Paropanisa, Aria, Draugiana, Arachosia, Caramania, and part of Armenia major, the which at this present are called by other names as you may see in the Map.

The Persians are a hardy and warlike people, and thought to be y best riders or horsemen in all the world, they have very hard wars with the Turks, they be of most free and gentle nature, lovers of civility, they make great account of learning and Sciences, they honour Nobility, wherein they greatly differ from the Turkes. Now as touching their religion they be Mahometists, and yet in such sort, as both they and the Turks do count each one the other as Heretiques in that religion.

From the Provinces of Persia are transported into other

parts of the world these Merchandizes, stones called Turquesses, very faire and excellent pearles, great quantity of Silk, Velvet Damask, armour, and a great number of most excellent horses.

The Contents of the ninth Page.

IN this page he describeth and setteth downe the shape of the pretious stone named Bezar, and the Dominions of the great Turke in Asia, and the City Aden in Arabia, also he describeth the beast called Camelopardalis, and setteth downe his shape, also he setteth downe the shape of three of the greatest Pyramides that are in Egypt.

Of the stone Bezar.

THe stone Bezar or rather Pazar (for that is his right name) groweth in Persia in manner de Boucz, named Pazan, which are of divers colours, but most commonly red.

This stone Bezar groweth in a concavity in manner of a girdle about two handfull long and three inches broad, it is medicinable, and of great efficacy against all manner of poysons and venoms, and many other maladies: there is to be found of them in the entry of Malcha, and also in Pegu, but the best of them are in Persia.

Of the Dominions which the great Turke hath in Asia.

THe great Turke doth possesse in Asia, Natolia, sometime called Asia minor, and almost all Armenia, Mesopotamia, called at this present Diarbach, or Diarbekir, Syria, and a great part of Arabia, the most notable Merchant Towns of this Country are these, Trapezunda, Aleppo, and a Port upon the Sea called Tripoli, also a Aman Damasco, with his Port Barutti, and Mecha.

The Merchandizes that are sent from these Provinces into other

other Countries are these, great quantity of Silke, Velvet, Damaske, Turkie Carpets, Cotton, and graine of Scarlet.

The City Aden.

ADen is the chiefe Merchant Towne of the upper part of Arabia, which is governed by divers kings, and this Town sendeth into other Provinces of the fairest Pearles, the true Balme, Frankencense, Mirrhe, and Horses.

The beast called Camelopardalis.

THis beast is called of the Arabians, Gyraffa, but the name Camelopardalis is compounded of Camel and Pardale which is a Leopard, he hath a long neck like unto the Camell, and is spotted with many spots, as is the Pardale or Leopard, he is a faire beast, and of gentle nature, as the heap, his head is like unto the head of a Hart or Stag, but greater, his hornes are smal topped, and covered with hayre, and are about a handfull and a halfe long, he hath eares, tongue, and feet, like to an Ore, his forelegs are long and tall, and his hinder legs are short whereby he seemeth alwayes to stand right up, his head is somwhat higher than the Camell, and this beast is to be found in Arabia, Æthiopia, and India.

The Pyramides.

IN Egypt are many Pyramides, whereof the two greatest are counted amongst the seven wonders of the world, the greatest of them (as witnesseth Peter Belon) who most diligently viewed the same, is at the foot foure square, and every square containeth in length 324 pares, and in height 250 degrees or steps, and every step hath in bredth 45 inches, which is three foot and 9 inches, but he setteth not downe what depth every step hath, which must not be over deep: for then how can any man easily mount up to the toppe thereof: for hee saith it is plaine on the toppe, and so large as 50 persons may stand thereon.

It is found by writing that 360000 men wrought 20 yéres in building this Pyramides.

The second great Pyramides is somewhat lesse and smoth on the out sides without any degrées or steps, and the top thereof is sharp pointed.

The Contents of the tenth Page.



N this page he describeth the Crocodyle, and setteth downe the shape thereof. Secondly he sheweth wherof the Mummie is bred. Thirdly he describeth the Unicorne, and setteth downe his shape.

The Crocodyle.

THe Crocodyle is found in Egypt, in the flud Nilus, and in India in the flud Ganges, and in the two Provinces Mexicana and Peruana in many Rivers. This is a foure footed beast, which hath a horrible head, sharp teth, a very small tongue, and a thicke taile, and his skin is hard and armed with hard scales, the nether part of his mouth is immoveable, and the upper part moveable, contrary to all beasts, hee doth devoure both men and beasts, and doth kéep more in the water than on the Land, and that which is greatly to be wondered at, he is ingendered of an Egge, as great as a Gwse-Egge, and he groweth by little and little untill he come to the length of 18 Cubites, or as some say 22 Cubites, which maketh 33 foot.

Of Mummie.

MVmmie is made of bodies embalmed, which they bring from Egypt, wheras many such embalmed bodies were buried, about foure houres journey beyond Cayre, wheras was sometime the great City of Memphis, for before the Nativity of Jesus Christ the Egyptians being Paynims did spare no cost to kéepe the bodies of their Parents from putrifaction, and therefore

therefore they are great palpable lies, whereby ſoules are perſwaded, that the Mummie proceedeth of thoſe bodies which do periſh in the ſands that be in the deſarts of Arabia, as though it were poſſible that thoſe bodies could be preſerved in thoſe ſands without ſtench or putrefaction.

Of the Vnicorne.

The Vnicorne, as Lewes Vertiman teſtifieth, who ſaw two of them in the towne of Mecha, is of the height of a young horſe or colt of 30 months old, which is two yeares and a halfe old, he hath the head of a Hart, & in his forehead he hath a sharp pointed horne three Cubits long, he hath a long neck, and a mane hanging downe on the one ſide of his neck, his legges are ſlender as the legges of a Goat, and his feet are cloven much like the Goat, his hinder feet are hairy, and his haire in colour is like to a bay horſe. This beaſt in countenance is cruell and wild, and yet notwithſtanding mixt with a certaine ſweetneſſe or amiableneſſe. His horne is of marvellous great force and vertue againſt venome and poyſon. The Vnicorne is found in Æthiopia, like as the Indian Aſſe is found in India, which hath likewiſe one only horne in his forehead.

The Contents of the 11 *page, wherein he firſt deſcribeth Afrique, and then certaine fruits and ſpices, as Nutmegs, Mace, and Cloves, and ſetteth downe the ſhape of them, then hee ſheweth which be the mightieſt Princes in Afrique, and thirdly he deſcribeth Mexicana, which is the firſt North part of America.*

AFrique being the third part of the world, is ſeparated from Europe and Aſia by the Sea Mediterraneum and the redde Sea, and by the ſtraight land which is betwixt Ægypt and Paleſtina, the chiefe Provinces of Afrique are theſe, Ægypt, Barbaria, Biledulgarid, Sarra, Æthiopia, Nubia, the large Provinces of the Abaſſines, falſly called the land of Preſter Iohn, and alſo Monomotapa. The moſt

most renowned Iles belonging to Africque are these, Socotora, Madagascar, S. Thomas, the Iles of Capo Verde, and the Iles of Canarie and Madera.

The Nutmegge tree.

The Nutmegge tree groweth in the Ile of Bada, and differeth not much from the Peach tree, saving that the leaves of the Peach tree are shorter and rounder: The fruit is covered with a thick barke or husk, which when it is ripe cleaveth in sunder, and sheweth the Nut together with the shell, which is covered with Mace, the which at the first view is as redde as Scarlet and pleasant to behold, but when the Nut wareth dry, the Mace do sever from the Nut, and losing by little and little their Scarlet colour, do war nigh unto the colour of an Orange.

Of the Clove tree.

The Clove tree groweth in the Iles of Moluccas, which in greatnesse and shape is like unto the Laurell tree, saving that the leafe thereof is somewhat narrower. It hath many branches, and a great number of flowers, first white, afterward greene, and then red, but being dryed, they become black. The Cloves do grow upon the outermost ends of the branches, one hard by another, and whilest the flowers are greene, they excell all other flowers in swet odour.

The chiefest Princes of Africa.

The most puissant Princes of Africque are these, the Emperour of the Moores or Ethiopians, which of the Arabians and of the Mahometists is called Aticlabassi, and of his own subjects, he is called Acegue, and Neguz of the Abassines, that is to say, Emperour and King of the Abassines and Moores. Then the King of Monomotapa, the King of Morocho, the King of Fez and Sus. The great Turk also possesseth many Provinces in Africque.

The

The chiefeſt Merchandizes that come from Afrique into Europe are theſe, Gold, Ivory, wood of Ebony, Aloes, Balme of Egypt, Mummie, Myrrhe, Anill feathers, Sugar, Ginger, Dates, and Wines of Madera, and of the Ile of Canarie.

Mexicana.

MExicana which is the fourth part of the world is on all ſides environed with the Sea, ſaving that nigh unto Nombre de Dios it is joyned by a land ſtrait to Peruana. The chiefe Provinces of Mexicana are theſe, the Province of Mexico, otherwiſe called nova Hiſpania, terra Florida, Norum Bega, nova Francia, Eſtotiland, Saguena, Chilaga, Tocontea, Marata, California, Tolm, Quivira, Agama, and Anian. The chiefeſt Iles lying on the North and Northeaſt part of Mexicana are theſe, Groynland, Crockland, Iſland, Freezland, Bacalaos, and Cuba.

The chiefe Merchandizes that come from Mexicana into Europe are theſe, Gold, Silver, Pearles, Cochenilles to dy with, Balme, Salſaparillia, the root Mechoicana, Brimſtone, hides of Oxen and Wolue.

The Contents of the 12 *Page.*

IN this Page he firſt deſcribeth the beaſt called in that tongue Aiotochli, in Spaniſh Armadillio. Then he deſcribeth the two Provinces, Peruana, and Magellanica, then hee ſheweth which bee the moſt mighty Princes of the world, and finally the divers qualities of the people inhabiting the world.

THe beaſt Armadillio is found in the Realme of Mexico, and he is no bigger than a Cat, he is headed like a Swine, and hath the fæt of a Perſon, and a long taple, hee is armed with ſcales, whereof hee taketh his name, he keepeth for the moſt

moſt part within the ground, and as ſome ſuppoſe, doth liue by the earth, by reaſon that he is neuer ſeene to eat abroad out of his den, the bones of his tails are medicinable, and do remedy the paine and deafneſſe of the eares.

Though Plancius ſaith that this beaſt is armed with ſcales, yet my countryman William Greenway, who is a proper ſeruitour both by Sea and Land, and hath beene in the Weſt Indies, and hath eaten of this beaſt, affirmeth his fleſh to be white and very delicate, and that he hath no ſkales, but that his ſkinne is white and ſmoth like to a pig new ſcalded, and that ſometime he will ſhrinke up the ſkin vpon his back into diuers pleates, and ſpecially towards his fore parts and hinder parts in ſuch ſort, as hee will make them almoſt to meet, and the formoſt pleates do hang downe vpon his ſhoulders like vnto two Poldrons, and his haire is white and ſhort, growing thin, here and there one, and he is eared and tailed like a Rat, euen as he is here portraied, ſaue that he is throughout of one ſelfe colour, and without ſcales.

Peruana.

PEruana being the firſt part of the world, is alſo inuironed on all ſides with the ſea, ſaue whereas the foreſaid landſtraight doth ioyne the ſame to Mexicana, & the chiefe Prouinces which it containeth are theſe, Braſilia, Tiſnada, Caribana, Carthagena, Peru, Charchas, Chili, Chica, and the land of the Patagones. The moſt renowned Iles are theſe, Hiſpaniola otherwiſe called S. Domingo, Boriquen, & Margarita, which is the Ile of Pearles.

The Merchandizes which are tranſported out of Peruana into Europe are theſe, Gold, Siluer, Emeralds, Pearles, the medicinable ſtone called Bezoar, Balme, Ginger, Sugar, wood of Braſill, wood of Guaicum, called Lignum vitæ, long Pepper, Pepper of Braſill, Caſſia ſolutiua, and hides of Oxen.

Magellanica.

THis is the firſt part of the world, which as yet is but little knowne, in ſuch ſort as we cannot write any thing touching the prouinces of the ſame, notwithſtanding it is thought that the

part

Province of Beach is very rich, and hath abundance of Gold. The chiefe Iles of Magellanica are these, Iava major, and Iava minor, Timor, Banda, the Molucques, Romeros, the Iles of Salomon.

From the Ile Timor doth come into Europe, the white and pale medicinable simple called Sandalum.

From the Ile Banda doth come Nutmegs and Maces.

And from the Iles Melucques Cloves.

Which be the great Princes of the World.

THe most mighty Princes of the world are these five, that is, 1 the King of China, otherwise called the great Cham, 2 the King of Persia, 3 the great Turk, 4 the Emperour of Æthiopie, 5 the Emperour of Russia, otherwise called the great Duke of Muscovia, amongst which the King of China, is a Pagan or Heathen, and the great Turke and the King of Persia are Mahometists: but the Emperour of Æthiopia and the great Duke of Muscovia do make profession of the Christian Religion. Now as touching the King of Spaine, his puissance should be much greater than it is, if his Provinces were not so separated, and so farre distant one from another.

The qualities of divers people in the World.

AS touching the quality of people, though God Almighty hath created all men of one selfe blood, and that al do take their beginning from the Arke of Noah, and that all men be of selfe quality and shape of body, yet they differ in greatnesse, in proportion of members, and in colour: for the Paragones do exceed all other creatures in greatnesse. Againe, the men of China have most commonly broad faces, little eyes,, flat noses, and little beards, and those that have smallest feet, are counted amongst them to be most beautifull, those of Africa have grosser and thicker lips than other people, the Inhabitants of Agysimba, and of Guinea, and specially of the lands that be nigh unto Cape de bona esperanza, are black, from whom the Orientall Indians do not much differ.

The

The Abassines or Moores of Ægypt, be of a duskish colour like to the Diuffe, the Inhabitants of Barbarie be called white Moores, and those that dwell betwixt them and the Nigrites or black Moores, be of a yellowish colour; the Spaniards have not found either in Mexicana, or in Peruana any Nigrites or blacke Moores, but only in certaine villages nigh unto Cusco, the other nations under the hot Zone, be of colour browne bay, like a Chesnut, and the nigher that they dwell to either of the Poles Arctique or Antarctique, the whiter most commonly they be, and as touching the rest, all are like in qualities, shape and fashion of body, as hath beene said before, wherefore they are meere lyes that are wont to be told of the Pigmeans, in that they should be but a foot and a halfe high, and likewise that which hath beene spoken of people, that should have their heads, their noses, their mouthes, and their eyes in thier breasts, or of those that are headed like a dogge, or of those that have but one eye, and that in their forehead, or of those that have but one foot, and that so great as that it covereth and shadoweth al their body, or of those that have great eares hanging downe to the ground. All those are meere lyes, invented by vaine men, to bring fooles into admiration, for monsters are as well borne in Europe, as in other parts of the world.

NOw in the foure pages following, he setteth downe in the French tongue an interpretation of the Latine inscriptions dispersed throughout the Map, every which inscription hath his number added, which I do here also set downe in the same order, joyning to every number his Longitude and Latitude, to the intent you may the more easily find out the said inscriptions, of which inscriptions there be in all 71 divided into five parts, whereof the first containeth 21 inscriptions belonging partly to Europe, but the most to Asia, the second part containeth 12 inscriptions belonging to Affrique, the the third part containeth 11 inscriptions belonging to Mexicana, the fourth part containeth 6 inscriptions, belonging to Peruana, and the fift part containeth 21 inscriptions belonging to Magellanica.

The

The 21 inſcriptions belonging to *Europe*, but moſt to *Aſia*, do here follow.

The number of inſcrip.	Longitude.	Latitude.	North or South.
1.	5.	85. 30′.	North.

This arme of the Sea doth take his courſe thorow three places, running continually towards the North Pole, and is frozen three months of the yeare, and it containeth in breadth about 37 leagues.

2.	38. 0′.	86. 30′.	North.

It is ſaid that this Country is inhabited of Dwarffes called in Latine Pigmei, being in heigth foure foot as thoſe be of Groynland, which are called Sereelings.

3.	81. 0′.	77. 0′.	North.

Muſcovia is bounded on the North ſide with the Sea Pitzorique, called of the ancient Geographers Mare Glaciale, that is, the frozen Sea, and towards the Eaſt it boardereth upon Tartaria, and towards the South upon the Sea called Mara Caſpium, and alſo upon the Turks, and Tartaries Perocopſiques, and towards the Weſt, it boardereth upon Lituania, Livonia, and upon the Realme of Swethland: as touching their Religion they obſerve the faith and ceremonies of the Greeke Church, al their Biſhops are called in their language Vſadiques, and alſo their Metropolitans are under the obedience of the Patriarch of Conſtantinople. The people is wiſe and ſubtill, and yet loving ſervitude more than liberty or freedome, and they all confeſſe themſelves to be the ſervants or ſlaves of the great Duke, having ſeldome or never peace, for either they have warres with thoſe of Lituania, or with thoſe of Livonia, or with thoſe of Swethland, or with the Tartarians, or if they have no wars, then they ly in gariſon nigh unto the two floods Tanais and Dwina, to defend their bounds from the depredations and inuaſions of the Tartaries, they charply puniſh robbers and ſtealers, and yet private theft and murder is ſeldome puniſhed with death: their ſil-

ver

The number of inscrip.	Longitude.	Latitude.	North or South.

ber mony is not round, but hath the forme of an egge, their country is every where full of woods, and they have great abundance of rich furres, they send into all countries of Europe very good Flax and Hemp to make Cables and Ropes, and a great number of hides, as wel of Oxen as of Elks, great bals of Wax, much salted fish, and Whales grease. The great Duke, called of his servants the Emperour of Russia, is rightly accounted amongst the most mighty Monarches of the world.

4.	98. 0'.	80. 0'.	North.

This arme of the Sea hath five mouthes or entries, and by reason that it is so straight, and hath so violent a course, it is never frozen.

5.	123. 30'.	58. 0'.	North.

Under the name of Tartarie at this day are comprehend al the Provinces that border towards the East upon the sea of China & towards the South, are limited with the Provinces of China, of India, with the flood Oxio, with the sea, Mare Caspium, & with the lake or Marish called Paulus Meotis, & towards the west they are bounded with the flood Boristhenes, & with the limits of Muscovia: for y Tartarians have conquered all the countries which they possesse at this present, so as Tartary comprehendeth al that country which the Ancient were wont to call Sarmiacia Asiatica, and also the Scythias, that is, intra Imaum and extra Imaum, they began first to be renowned in Europe, in the yere of Christ 1212. The Tartarians are divided into certaine commonalties, and Colonies, called of them Hordes, but for so much as they dwell in divers Provinces, that do extend far, and be far distant one from another, they differ also in their manners and trade of life, they be men of square stature, having broad and grosse faces their eyes hollow sunk into their heads, and looking somewhat asquint, and thick beards, they be strong of body and hardy, they eat horses, and all other beasts, howsoever they are slain, saving hogs, from which they abstaine, they are able to endure hunger, thirst, watch, and all discommodities, and when they are distressed

The number of inscription	Longitude	Latitude	Number South
8.	171. 30.	89. 39.	North.

distressed in their voyages with hunger and thirst, they let their horses bloud, & with that bloud quench their hunger and thirst, which kind of cure they call in their language Belermanen, they call their Emperour Cham, & his seate or throne, they say is in Cambalu, which is interpreted to be the seat or throne of the Prince.

6.	125. 40.	80. 0.	North.

It is found also in the Annales of Sotio, that in the originall and beginning in the yeare 1567. by reason of an inundation or flood, which carried away 7. Dolmas of villages, and other places nigh adioyning, and a great multitude of people, whereof none were saved, but in one instant, sitting upon trees.

7.	124. 0.	27. 0.	North.

The Inhabitants of China are of good capacity in matters, insomuch as they have invented certain kind of Carts, wherein they may saile upon even ground, having sailes and saile as they doe in ships upon the Sea.

8.	171. 30.	89. 39.	North.

Plancius in this inscription setteth downe the opinion of Mercator touching the beginning of longitude, and drawing the Adamant stone, otherwise called the Loadstone, in Latine Magnes.

Francis of Diep, a most skilfull Pilot, doth witnesse that the needle of the Mariners Compasse, doth not directly vse to the North Pole, being in the Ilands of Capo verde, that is to say, the Ile of Sal, the Ile of Bonavista, and the Ile of Maio, whereunto those doe agree very nigh, which doe say that the Needle doth the like in the Iles of Tercera, and of S. Marie, which are part of the Flemish Iles, otherwise called the Azores: but some others do affirme, that the Needle sheweth the North Pole best, being in the Ile of Coruo, which is the furthest Ile West ward of the said Azores. And because the longitude of places by most apt reasons, ought to take his beginning from the common Meridian of the world, and from the Rocke or Pole of the Adamant stone,

The number of Inscript.	Longitude.	Latitude.	North or South.

we here following the opinion of those that are most skilfull in this matter, have set downe the first Meridian betwixt the Iles of Capo verde, and the Azores, and because the Needle in all other places declineth either more or lesse from the Pole of the World, there must needs be another Pole in some one place, whereunto the Needle doth incline from all coasts of the world, and it is found by the declination of the Needle observed at Ratisbone, where it is called Regenberg, that is the same place which I have set downe in the Mappe, and I have likewise marked in this Card, the situation of the Pole of the stone, in respect of the Ile Corvo, to the intent that according to the outermost plates limited by the first Meridian, the outermost bounds betwixt which this Pole ought to be found, might bee knowne, untill the diligent and curious consideration of the Pilots shall bring us something of more certainty. Thus farre Mercator.

9.	162. 0.	71. 0.	North.

These are the plaines fields or Bargu, whereof the inhabitants are called Mecriti.

10.	195. 30.	68. 0.	North.

The mount Askai, in which are to be seene the Sepulchers of the Kings of Tartary.

11.	171. 30.	70. 0.	North.

Upon this mountaine are set by the Tartarians two trumpetters of Brasse, for a perpetuall memory of their freedome gotten.

12.	175. 0.	67. 0.	North

The Province Vng, in which of our men is called Gogo.

13.	170. 30.	65. 20.	North.

The Realme of Tendus, which in the the time of Marcus Pa-

lus.

The number of inscript.	Longitude.	Latitude.	North or South.

lus Venetus, (which was in the yeare 1290) was governed by those Christians, which descended from the King of Vncham.

14.	165. 30'.	65. 0'.	North.

The Castle of King Vncham was builded in this place against the invasion of the Tartarians.

15.	157. 0'.	65. 30'.	North.

The Province Mongul, which of our men is called Mogog.

16.	159. 20'.	66. 0'.	North.

The desart Belgian, which is very great, all sandie and barraine.

17.	159. 0'.	61. 30.	North.

In this Countrey of Cergutha, is found the best sort of musk, which groweth like an impostume or bagge, nigh unto the navell of a certaine beast.

18.	165. 0	58. 0.	North.

Campion is the Metropolitane Towne of Iangath, whereas the Inhabitants are partly Christians, partly Idolaters, and partly Mehomatists.

19.	158. 0.	53. 0'.	North.

This wall hath in length 400 Spanish leagues, and was built betwixt the mountaines by the King of China, against the invasions and excursions of the Tartarians.

20.	176. 0'.	40. 0'.	North.

Iapan hath three Ilands much renowned, separated one from another by a scrait of the Sea, whereof the first and greatest is divided into 33 Provinces or Realmes, of which Meaco is the Metropolitane Citie, the second called Xima, which hath nine Provinces or Realmes, the third is called Xicoca, which containeth but foure Provinces or Realmes.

21	71. 0'.	31. 30'.	North.

Medina Talnabi, is the Towne wherein is to bee seene the Sepulchre of Mahomet.

The twelfth inscription, belonging to Affrique.

The number of inscripc.	Longitude.	Latitude.	North or South.
1.	67. 0'.	26. 0'.	North.

Coptos is a trimme Marchant Towne, whereto are brought the Marchandizes of India, and of Arabia, in which Towne are dwelling many Christians.

2.	58. 0'.	31. 0'.	North

The flood Nilus, which by his inundations doth verely water and fatte the country of Egypt, and maketh it marvellous fruitfull.

3.	58. 0'.	17. 0'.	North.

The flood Nubia, taketh his originall from the lake Nuba, as Ptolomie saith.

4.	50. 0'.	15. 0'.	North.

The flood Niger, here taketh his course, running under the ground 20 leagues.

5.	62. 0'.	5. 0'.	North.

In this place is the ample jurisdiction of the Emperour of Æthiopia, wrongfully called by those of Europe, the land of Prester John, the Arabes and the Persies do call him Aciclabassi, but his owne subjects do call him Acegue, and Neguz, that is as much to say, as Emperour and King.

6.	58. 30'.	2. 30'.	North.

The mount Amara, whereas are most carefully kept with continuall watch and ward all soules, the children and grandchildren of the Emperours of Æthiopia.

7.	53. 0'.	7. 0'.	South.

It is said that this Country is inhabited of Amazones, which are women that make warre.

8.	55. 40'.	20. 0'.	South.

In

The number of inscrip.	Longitude.	Latitude.	North or South.
In this place the King of Monomotapa, hath his great and ample jurisdictions.			
0.	42. 20'.	15. 40'.	South.
The South part of Affrique, unknowne to the ancient writers is called by those of Persia and of Arabia, Zanzibar.			
10.	45. 30'.	1. 0'.	South.
Here is digged out of the Mines great abundance of gold.			
11.	30. 20'.	20. 0'.	North.
Libia, or inward Affrique, is at this day called Sarra, or the deserts.			
12.	19. 0'.	15. 30'.	North.
The people Azonagi, are of colour blacke gray, and they cover their mouthes as a member of shame, and doe never uncover them but when they eate.			
The eleventh Inscriptions belonging to Mexicana			
1.	301. 30'.	81. 0'.	North.
This Ile is thought to be the best and most wholsome of all the North parts.			
2.	310. 0'.	74. 0'.	North.

The Ile of Crockland, the Inhabitants whereof say that they had their originall from Swethland.

In the yeare of our Lord 1500, one Gasper Corterial a Portugall, entred into these Regions, hoping to have found some passage on the North towards the Iles Molocques, but arriving at the River, which by meanes of the abundance of Snow there falling, is called Rio Nevado, which hath in North Latitude 62 degrees, he did leave to saile any further towards the North, by reason of the great cold there, and turning to the South, did seeke in all the Sea-coasts untill he came to Capo Razo, which hath in North Latitude about 48 degrees: in the yeare 1504. The Brittans were the first that

The number of inscripts.	Longitude.	Latitude.	North or South.

discovered all the sea coasts of new France in America nigh unto the Gulfe of S. Laurence, which hath in North Latitude about 50 degrees, and in the yeare 1524 John Verazzana, and Florentine, did part from the Port of Diep, the 17 of March in the behalfe of Francis King of France, and sailed toward the South sea coast of new France, whereas he arrived at the 34 degree of North Latitude, and from thence sailed towards the East, viewing all the sea coast untill he came to Cape Britaine, which hath in North latitude about 46 degrees.

3.	283. 0'.	61. 30'.	North.

And in the yeare 1534, new France was againe visited by the Admirall Iaques Cartier, and in the yeare next following, it was conquered to the use of the King of France: also in the yeare 1577 Martin Forbosher Englishman arrived at the North strait which is betwixt Groynland & Estotiland, y place having by this Map in the North latitude 65 degr. seeking passage by the North unto Cathay, whereas he found certaine Iles, & a mine of gold, wherewith having lode his ships, he returned into England with great hope of profit, but his successe was not answerable to his hope.

4.	275. 30'.	70 0'.	North.

This dangerous beast is called Sucaratha, which being chased of Hunters, doth take her young ones upon her backe to save both her selfe and them by flight.

5.	271. 0'.	64. 30'.	North.

This is a great lake or sea of fresh water, the limits whereof are unknowne, as they of Canada do say, and as they have heard by relation of those of Saguenay.

6.	293. 30'.	52. 0'.	North.

Alongst this River a man may saile very commodiously towards the Country of Saguenay.

7.	287. 0'.	44. 40'.	North.

All those that dwell betwixt Terra Florida, & Terra de Labrador, be called by one common name Canadois, but there be many

The number of inscripc.	Longitude.	Latitude.	North or South.
7.	287. 0'.	47. 40'.	North.

ny others nations, as those of Hochelaga, Honqueda, & Corterealia they are all very courteous to strangers, they live commonly by fish, and they are cloathed with skins of wild beasts, as they be also that dwell further towards the North. This Country is also called new France, because the Britans which are Frenchmen did first discover it in the yeare of our Lord 1504. the conquest whereof was atchieved by the Admirall Iaques Cartier in the yeare of our Lord 1535 to the behoofe and use of the french King.

In the mountaines towards the South, doe dwell many and divers nations, which be cruell people, living without any law, and doe seeke by continuall warres to ver & oppresse one another, as the people Avanares, Albardi, Caliguares, Tegiles, Apalchoni, Mocose, Capaschi, Chilage, & many others, amongst which there be some of such agility and swiftnesse, as they may contend with horses who can run fastest: they eat as those of Florida, certaine kind of Spiders, Ants or Pismires, Leazards, Adders and other venomous beasts. The land of Baccalaos is so called of the fish Baccalaos, which is there taken. Terra florida is so called of Easter day, because Iohn Ponce of Lion did discover it on Easter day, in y yeare 1512, the which day is called of the Spaniards Pasqua du Flores, this is a fertill Country and rich in gold.

8.	271. 0'.	29. 0'.	North.

Marcus Nizza reuiueth that this Province called the seuen Cities is a very good Countrey, with whom Francis Vasker doth not agree, for he saith they be places of no value, and like to villages, and be under the iurisdiction of Cevola, which at this present is called of the Spaniards Nova Granada.

0.	211. 40'.	82. 0'.	North.

The North Ocean sea, entring with 19 mouthes betwixt the Iles of the North, doth make foure straits of the Sea, and raining flouds, which continually take their course towards the North, and there are swallowed into the bowels of the earth, like to springs of Fountaines and flouds

The number of inscrip.	Longitude.	Latitude.	North or South.

In mine oppinion his Inscription would have bæne one of the first of Mexicana, and not one of the last, sith it is no small leape, to tarne so sodainly from the middest of America to the North Pole.

10.	223. 0'.	55. 40'.	North.

This country is desert and plaine, in which are many wild Horses or Oxen, with high backs like Camels, and wild sheepe like unto those which Boetius writeth (in his description of Scotland) to be found in one of the Iles of Hebrides.

11.	240. 20'.	40. 30'.	North.

New Spaine was brought by force of armes under the obedience of the Spaniard in the yeare 1518. by their Generall Fardinando Cortes, who conquered the same with great losse of his Souldiers, but with greater ruine to the inhabitants, who fought for the liberty of their Country: the soile is very fertill and the Country is rich in gold and silver, for in the floods are found great lands of gold, and in the Mountaines is drawne out of the Mines great quantity of silver, and along the Sea-side they take to their great profit an infinite number of Oysters, wherein are found very faire Pearles. In this province there are many salt lakes, the water whereof by force of the Sunne is turned into salt: there groweth also great abundance of Cassia fistula, and another kind of fruit, which the Inhabitants cal in their tongue Cacaco, it is like to an Almond, they have it in great price, for of it they make a certaine drinke, which they love marvelous well. The sea and floods which doe wash this Province, doe furnish them with great plenty of fish: and in those floods are many Crocodiles, whose flesh the Inhabitants doe eate, and this beast will grow to be twenty foot long and a-bove. This country is full of great mountaines and high rocks there is great diversity of languages, insomuch as one understandeth not another without an interpreter. Mexico is the Metropolitane and Royal towne, or rather the Queene of al the principall townes in the world. It is situated upon the side of a

lake

The number of inscripd	Longitude.	Latitude.	North or South.
11.	240. 20'.	40. 30'.	South.

lake or marish, yea the very foundation of it is a very marish, in such sort as you can neither enter into it, nor come out of it, but by bridges, and it is as well peopled with Inhabitants and Merchants, as any renowned Merchant Towne in Europe. The Towne is very great, for it containeth in circuit 3 Spanish Leagues.

The sixth inscriptions belonging to Peruana.

1.	222. 0'.	3. 30'.	South.

This great flood Maragnon, is called of some Oreigilana, and also the flood of the Amazones, it is discovered by Vincet Iohn Pinsonio, in the yeare 1499, and was sailed into a mannet from the head spring even unto the Sea, by Francisco Oreigliano in the yeare 1542, the which voyage he performed in eight moneths having sailed 1660 Leagues. This River keepeth his water still fresh after it is entred certaine Leagues into the Sea, by reason that his course is so swift and violent.

2.	330. 30'.	32. 0'.	South.

Peruana is the South part of America, and is divided by the Spaniards into five goodly Provinces, that is to say, Castiliador, that is to say, the golden Castilia, Pomparaba, Peru, Chila, and Brasille. The Provinces Peru (before the arrival of the Spaniards) did extend a great deale further, when as their Countrey was yet under the government of their naturall King, which then was called Ingas, as Girama others do write. But this present it is limited on the North with the Towne Quito, and towards the South with the Towne of Plata, that is to say, the silver Towne, and it was called Peruana as some write of the flood and Port of the Sea called Peru. It is at this present divided (according to the situation of the Countrey) into three parts, that is to say, Sierras, Andes, and the flat or plaine Country.

The plaine Country is that which lyeth alongst neare to the Sea-coast.

Sierra.

The number of inscrip.	Longitude.	Latitude.	North or South.
2.	330. 10'.	22. 0'.	South.

Sierra is that part which is full of mountaines, and Andes is that part of the mountaines which tendeth towards the East. Of all the Provinces in the World, this is the richest in gold, and in Emeraldes. The Metropolitan Towne of this Province, is the City Lyma, otherwise called the Towne of Kings. Castillelledor tooke the name of the great abundance of Gold that is there. The Province Propaiana tooke his name of the renowned Towne Propaian. Chila is a cold Countrey, by reason that it is nigh unto the South Pole. The Province Brasilia tooke his name of the wood called Brasill, which groweth there in great abundance. To these Provinces were meete to be joyned these other Provinces, that is to say, Caribana, Charchas, Chica, and the land of the Patagones.

3.	329. 0'.	28. 0'.	South.

This beast is called of some *Haute*, but of a certaine people of Brasil is called Haye, which beast was never knowen eat or drinke, as some write, and therefore some thinke that she liveth without meat or drinke, only by the Aire.

4.	328. 0'.	35. 2'.	South.

This kind of beast is found in the Province of Parias, which in her fore part is like a Fox, and behind she is like an Ape, saving that she is hooded like a man, and she hath the eares of an Owle, and under her ordinary belly she hath also another belly, which openeth and shutteth, wherein she lodgeth her young ones, until they are able to get their owne living, and she never suffereth them to get out, but only to sucke. Gesner calleth this beast an Ape, some, or a Fox Ape.

5.	329. 30'.	36. 30'.	South.

This is the land of the Patagones, the inhabitants whereof are Giants nine or ten foot high, which doe paint their visages with divers colours made of herbes.

The Number of inscrip.	Longitude	Latitude.	North or South.
6.	335. 0'.	51. 30.	South.

In the yeare 1582, the King of Spaine commanded here to be built certaine fortresses at the entry or mouth of the straight called Mare Magellanicum.

The 21 inscriptions belonging to Magellanica.

1.	188. 30.	17. 20.	South.

This Land is new Guinea, so called of the Navigants and Pilots, because the Sea Coast and situation thereof is like to that of Guinea in Africque, and it was called by Andrew Corsali a Florentine, the Land of Piccinacoli, and perhaps it is that which Ptolomie calleth the Ile Labadia, if it may bee called an Ile, for it is not yet knowne whether it be any part of the South firme land or no.

2.	209. 0'.	32. 30.	South.

It is not unknowne to all those that are exercised in Geographie, that the degrees of Longitude doe diminish and decrease from the Equinoctiall to either of the Poles either North or South, whereby it falleth out, that the Provinces which are nere unto the two Poles of the World, doe differ greatly from that naturall shape which they have by reasons of the earth, and for that cause wee have briefly drawne a description of the whole world in two round figures or circles at the end of this map, to the intent that every man might see their naturall situation so farre as may be shewed in Plano, that is to say in flat forme.

3.	231. 0'.	72. 0'.	North.

These Provinces at this present are little knowne, yet it is said, that they are full of many kinds of wild beasts. Yet shall find this inscription in the round figure on the left hand nigh to the North pole, which indeed belongeth to Mexicana, and not to Magellanica

4.	247. 30.	14. 0'.	South.

These two infortunate Ilands were so called by Magellane himselfe, because he could find in them neither men, nor any thing

else.

The number of instepe.	Longitude.	Latitude.	North or South.
4.	247. 20'.	14. 0'.	South.

Ile that was made for mans sustenance.

	283. 0'.	61. 20'.	South.

These Provinces were discovered by a Spaniard, who being separated by tempest at Sea from the Fleet or Armie, ran wandring here and there through this great Southerne Sea.

6.	350. 40'.	83. 30'.	South.

In the yere 1492. when as they were to saile into far Countries, increased more and more amongst the Castillans, and Portugals, and that with great contention who should discover most. Pope Alexander ordayned, that the Meridian which is 100 leagues distant towards the West, from every one of the Ilands as well of Capo verde, as of those which they call Azores, should bee the bounds and limites to either party for their Navigation, determining their rights in such sort, as the Castillans should have the West part of the World without out knowne Countries, and the Portugals the East part, but there was such strife and contention betwixt them afterward touching the bounds of Navigation, as this ordinance of Pope Alexander pleased neither party, and therefore in the yere 1524. it was fully determined that the Meridian which is distant 370 Leagues towards the West from the Ile S. Antonio, being the most Westerne Ile of all the Iles of Capo verde, should be the common bound of Navigation to both parties.

7.	19. 0'.	54. 30'.	South.

Here under the latitude 42 degrees, and distant 450 leagues from the Cape de bona Speranza, and also 600 leagues distant from the Cape S. Augustine, was found the Promontorie of the Southland, as Martin Ferdinando Denelso hath noted in the Epitome or summe of his Geography.

8.	22. 0'.	65. 0'.	South.

In this our Geography, we have in such manner described the circuit of the whole Earth, as all the Countries are situated

The number of inscript.	Longitude.	Latitude.	North or South.
8.	22. 0′.	65. 0′.	South.

ted under their proper Meridians, which could not have beene done without extending them more or lesse from the West towards the East, notwithstanding being desirous to satisfie those that are practised in the Art of Navigation, we have described the North Provinces of Europe in this our Geographie, in such sort as their situation wholly agreeth with the particular Mariners Cards.

9.	57. 30.	54. 0.	South.

The ninth Inscription intituled to the lovers of Geographie. We have in this inscription of the whole Earth employed all diligence to describe all the Seas and Provinces, in such sort as every place may have his true longitude and latitude, in which matter we have spared neither labour nor cost, for we have diligently conferred together the Sea Cards, as well of the Castili, as as Portugals, which they use in their Navigations to America, and to India, and among st others we extracted from Portugal a Mariners Card, describing the whole Earth very correctly, and besides that fourteene other particular Cards, in the which likewise all the Seas and Provinces of the whole world with their situation were compiled: all which Cardes, being compared together, we here now set forth this new description of all the Provinces and Seas in the whole World, and that as correctly as may be, according to the consideration and observation which hath beene used by the most expert Geographers and Pilots, even unto this present houre: for in this Card we do describe all the Sea coasts, Promontories, windings in and out, Iles, Ports, Depths, Sands, Shoulds, and Rocks, also we have added thereunto in place convenient, the Mariners Compasse, and the lines of the Winds, which we have set downe as correctly as was possible for us to doe, for the commodity of Navigation: and for so much as the true Longitude of the places cannot well be observed, without extending or enlarging too far those Provinces that are nigh unto the North or South pole of the

The Number of inscrip.	Longitude.	Latitude.	North or South.
9.	57. 20.	54. 0.	South.

the World, we have briefly therefore comprehended the same in this our description of the world, in two rundles or circles, unto the which we have added another little Geographicall Card, comprehending the North Provinces of Europe, to intent that in them every man may see with his eyes ỹ naturall situation of those Provinces as well as it may be done in Plano, as is more amply declared in other inscriptions of this Map. And this little Septentrionall Map, last mentioned, is placed at the foot of this Map, in the very middest thereof comprehending all the North parts that lye betwixt the 52 degrees, and 72 of Latitude.

10.	79. 30'.	56. 0'.	South.

Here is a very strong current of the Sea, which runneth East and West betwixt Madagascar and the Ile Romeros, in such sort as Navigation there is very troublesome and laborious, as Marcus Paulus Venetus testifieth in his third Booke & 40 Chapter: whereof it must needs follow of necessity, that the Sea coasts of this Countrey are not farre distant from Madagascar in such sort as the great Oriental Sea doth ebbe and flow through this Strait with great violence into the West Ocean Sea, whereunto agreeth the letter missive of a Candior, who was Embassadour for the Venetians to the King of Portugall. In which letter hee writeth that the men of this Countrey got all naked.

11.	91. 0'.	35. 0'.	South.

To this place arriveth a Portugal ship called S. Paul.

12.	112. 0'.	36. 0'.	South.

The South firme Land is called of some Magellanica of Ferdinando Magellanus, who first discovered the same.

This inscription, together with the foure next following, are to be found in the rundle on the right hand.

13	146	46	South.

Marcus Paulus Venetus, and Lewes Vertoman doe testifie in their Bookes of peregrination, that heere be very great and ample Deserts. &c.

The number of inscript.	Longitude.	Latitude.	North or South.
14.	75.	25.	North.

Betwixt the Ile of S. Laurence and the Iles of Romeros, do fall a most violent flore and reflure of the Sea, East and West.

15.	46.	55	South.

This is the Land of Papeniades, so called of the Portugals because those Birds in that Country are of incredible bigneſſe.

16.	15.	46	South

This Promontorie of the South Land is situate 450 Spanish Leagues from the Cape de bona speranza, and 600 leagues from the Cape of S. Augustine.

17	148. 0'.	34. 0',	South.

As we have in the first rundle on the left hand set downe the description of that part of the World, which extendeth from the Equinoctiall to the North Pole: so in this other rundle we have set downe a description of that part of the World, which extendeth from the Equinoctiall to the South Pole, in such sort as this Rundle containeth all Magellanica, and almost all Peruana, together with a great part of Africque, and a great number of the most Noble and Renowned Iles in the World, and herein you may plainly see with your eye the naturall situation of those Provinces that are nigh unto the South Pole.

18.	148. 30'	20. 30'.	South.

The Realme of Maletur abounded in all manner of spices.

19.	148. 0'	15 40'	South.

The Countrey of Breach abounded in gold, but little frequented by Marchants of other Countries, by reason of the cruelty of the people.

20.	161. 0'.	20. 0'	South.

Iava Minor, bringeth forth divers spices which have not yet beene seene in Europe, as Marcus Paulus Venetus testifieth in his third booke 13 Chapter.

21.	170. 40'.	3. 0'.	North.

The

The Iles Moluccas are much renowned for the great abundance of Spices, which are sent from thence into all Countries of the World: The chiefest of those Iles are these, Ternate, Tidoris, Motir, Machian, and Bachian, unto which some doe adde Gilolo, Celebes, Burro, Amboino, and Bandan.

Besides all these Inscriptions Planetus at the foure corners of his Map setteth downe 4 Rundles, two above, and other two beneath: and in that above on the left hand, representing the Northerne halfe of the Celestiall Globe, he describeth all the North-Starres that are already, and in the other Rundle on the right hand, representing the Southerne halfe of the Celestiall Globe, he doth not only set downe such Southerne Starres as were knowne to the ancient Astronomers, but also such Southerne Starres as hath beene found out of later dates, by those that have travailed into the East and West Indies, as the Crosse, the Southerne Triangle, Noes Dove or Pigeon, and another in the shape of a man called Polophilax, and certaine others, touching which Starres he setteth downe nigh unto the foresaid Rundle, a certaine inscription written in the Latine tongue, which I have here interpreted word for word in our mother tongue as followeth.

We have here set downe the fixed Starsin their true places, answerable to the yeare 1592.

Of the South Pole and of the Starres that are about the same.

LEast the South part of this Hemi-sphere or halfe Globe, should remaine void and empty, I have taken these Southerne Starres of the observation of Andreas Corsalius Florentine, and have diligently compared the same with the writings of Americus Vesputius, and of Petrus Medina, and have reduced the said Starres into this forme or shape. Where-for so

so much as I haue seen nothing as yet to my satisfaction or contentment touching the Longitude, Latitude, Magnitude or nature of the said starrs, I hartily pray al those that haue any more certain knowledge of this matter then we, that they will informe vs thereof for the common good of all men: As touching the Pole Antarctique Corsalius writeth, that there be two cloudie starres of a meane bignesse, which with a Circular motion doe goe about another starre, that is distant from the Pole almost 11. degrees, and are sometime aboue and sometime beneath the said starre: Hitherto Plancius. But now to the intent that you may the better vnderstand all the foresaid rondles, I thinke it not amisse to describe the same vnto you, and to shew the vse thereof as followeth. You haue to note then, that of the two vpper rondles, that which is on the left hand, signifieth the Northerne halfe of the Celestiall Globe, and the other rondle on the right hand, signifieth the Southerne halfe of the said Globe as hath beene said before, and each one of these rondles is traced with certaine Circles and Lines: The outermost Circle whereof being deuided into 360. degrees, and containing the Characters of the 12. Signes, signifieth the Zodiaque, or rather the very Ecliptique if selfe, the Centre of which Circle is the Pole of the Zodiaque, which by continuall turning about describeth another lesser Circle hard by it, signifying in the North rondle the Circle Arctique, and in the South rondle the Circle Antractique, the Centre of which lesser Circle in either rondle is the Pole of the World, both which Poles are distant from the Pole of the Zodiaque 23. degrees 28. which is the greatest declination of the Sun. Moreouer in either rondle are drawne vpon each Pole the of world two other Circles, the largest whereof signifieth in both rondles the Equinoctiall, and the lesser thereof in the North rondle, signifieth the Tropique of Cancer, and in the South rondle the Tropique of Capricorne: besides these Circles each rondle is traced with 12. right lines, signifying those sixe Meridians or Lines, which passing through both the Poles of the Zodiaque doe deuide the Zodiaque into 12. equall parts, euery part containing 30. degrees: for so many degrees doe belong to the Longitude of euery one of

the 12. Signes, whereby the Zodiaque hath in Longitude 360. degrées, which Longitude is to be counted from the first point of Aries and so forth, according to the succession of the Signes: and by helpe of these lines, you may know vnder what Signe any fixed starre is: I shall not neede here to shew you how the said fixed starres are situated in either of the rondels, nor how they are named, because their Images or shapes together with their names are apparant for your eye. But if you would know the true place, the Longitude, Latitude, Magnitude, and the nature of any fixed starre herein contayned, then doe thus: first to know the place and Longitude of any starre, lay a Ruler or extend a Thread, so as it may passe through the Pole of the Zodiaque, and also through the body of the starre, whose place and Longitude you seeke, euen to the very Zodiaque, & somewhat beyond, and thereby you shall know in what Signe, and in what degrée thereof that starre is, for that is his place, and you shall know his Longitude by counting from the first point of Aries vnto that degrée, for that is his Longitude.

Now to know the Latitude of any starre, you haue to note that in each rondle there is a certaine right blacke line extending from the Zodiaque to the Pole, deuided by vnequall spaces into 90. degrées, which line is called the scale of the fixed starres Latitude, the vse whereof is thus: Set the firme foot of your Compasses in the very Pole, and extend the other foote into the middest of the body of that starre whose Latitude you seeke, and turne that foote standing at that wideneste to the scale, and the number of degrées written vpon the scale, if you count from the Zodiaque vpward towards the Pole, will shew you the Latitude of that starre. Againe, to know the magnitude of any starre, Plancius setteth downe in the North Rondle the selfe same meane which Mercator also vseth in his Celestiall Globe, that is to say, by making certaine shapes of starres representing the bignesse of euery starre, according to his greatnesse, that by marking and comparing those shapes together, you might finde out, or rather coniecture the greatnesse of the starre which you seeke. Lastly he sheweth the nature of any starre, by setting downe nigh vnto the starre the Characters of those Planets, of whose nature that starre

doth

both participate, all which things you shall more plainly vnderstand by this example here following.

Suppose that you would know the place, longitude, latitude, magnitude, and nature of the star called Arcturus: here because this is a North star, you must therefore resort to the North rondle and there seeke out the Image Bootes, betwixt whose legs is the starre called Arcturus which you seeke. And by extending a thread which may passe through the Pole, and also through the body of that star, euen to the Zodiaque, and somewhat beyond, you shall finde his place to be in the 19. degree of the signe Libra, and his longitude counting from the first point of Aries vnto that degree, to bee 199. degrees, and by obseruing the rule before giuen, touching the knowing of the latitude of any star, you shall with your Compasse finde the Latitude of this star to be almost 32. degrees Northward, and by his shape you shall know that hee is of the first magnitude. and the Characters of the two Planets Mars and Iupiter, placed hard by him, doe shew that hee is of their nature, that is to say, by participating of Mars he is extremely hot and drie, and by participating of Iupiter he is hot and moist, and looke what order is to be obserued in the North rondle, touching the North starres, the same is likewise to bee vsed in the South rondle containing the Southerne starres: amongst which you may see the Image called the Crosse, whereby most Pylots in these dayes doe chiefely direct their course, being once past the Equinoctiall towards the South pole, which Crosse though Plancius doth here make to consist of fiue starres, yet I am sure that Martin Cortes and Peter Medina, and all other late Writers doe appoint thereunto but foure starres, the shape and vse whereof I haue set downe in my Treatise of Nauigation, according to the direction of Peter Medina. And those that haue trauelled into the Indies, doe all affirme that to the Crosse there doe belong onely foure starres and no more, wherefore I maruaile much that Plancius doth set downe fiue, whereunto perhaps hee is induced by the relation of some Spaniard that did misstake them. Thus hauing described vnto you the two vpper rondles, representing together the Celestial Globe, & also shewed the vse thereof I will now describe the two nether rondles, wherein that on

the left hand representeth the North halfe of the Terrestriall Globe, and that on the right hand the other halfe of the same Globe, towards the South.

You haue then to vnderstand that the Centre or middle point in each rondle, signifieth the Pole of the World, that is to say, the North Pole in the North rondle, and the South Pole in the South rondle, and vpon each Pole are drawne certaine Circles, the outermost whereof, and furthest distant from the Pole, signifieth the Equinoctiall, which is diuided into 360. degrées, euery degrée containing 60. miles, which is the whole Longitude of the Earth, from which Circle at the end of euery tenth degrée, are drawne certaine right lines to the number of 18. which doe meete in the very Pole, and doe signifie halfe Meridians, whereof that which passeth through the Iles Azores, and also the Iles of Capo Verde, is the first Meridian, from whence the Longitude of the Earth taketh his beginning, and there also endeth: which Meridian in the rondle of the left hand, is deuided into 90. parts, proceeding from the Equinoctiall to the Pole, signifying the North Latitude of the World: the like deuision and number of degrées of Latitude, hath also the first Meridian, in the rondle on the right hand, sauing that the said Meridian tendeth vpward. Moreouer you haue to vnderstand, that in each of these rondles are drawne nine Circles, equally distant one from another, called Paralels, which together with the Equinoctiall, doe make nine spaces, euery space containing 10. degrées, and besides these Circles, there are drawne in each rondle two other Circles, the one greater and the other lesser. The greater in the rondle on the left hand being distant from the Equinoctiall, 23. degrées 30. which is the greatest declination of the Sunne, is called the Tropique of Cancer, and the lesser Circle being of like distance from the Pole, is called the Circle Arctique, but the greater Circle being of like distance from the Equinoctiall, in the rondle on the right hand, is called the Tropique of Capricorne, and the lesser Circle in the said rondle inuironing the Pole, is called the Circle Antarctique, vpon which Circles in each rondle you shall find their names written. The chiefest vses of these two rondles are these: first to finde out the

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Longitude of any place, secondly the Latitude, and thirdly the distance betwixt any two places.

To find out the Longitude of any place, you must doe thus: Extend a thred, so as it may passe thorow the Pole, and also thorow the place whose Longitude you seeke, even to the very Equinoctiall, and somewhat beyond, and holding the thred straight, the numbers of the degrees written upon the Equinoctiall will shew the longitude of the place.

And if you would know the latitude of that place, or of any other, doe thus, Set the one foot of your Compasse in the very Pole, extending the other to the place whose Latitude you seeke, and keeping your Compasse at that wideneſſe, bring the moveable foot to the first Meridian, whereon the degrees of Latitude are marked, and there staying it, the number of the degrees, counting from the Equinoctiall upward towards the Pole, will shew the Latitude of the place: As for example, suppose that you would know the longitude and latitude of Lisbone which is a famous Towne in Portingall, here having first found out that Towne in Spaine, which is nigh unto the West Ocean, extend your thred from the Pole thorow the middeſt of that Towne to the Equinoctiall and somewhat beyond, and you shall finde that the thred will cut the Equinoctiall in the 13 degree, which is the Longitude of Lisbone. Now if you would know the Latitude of that same place, set the one foot of your Compasse in the Pole, and extend the other foote to Lisbone, and keeping your Compasse at that wideneſſe bring the moveable foote to the scale of Latitude, and so you shall finde that Lisbone hath in North Latitude 38 degrees and 30'. Now to know the distance betwixt any two places doe thus, Set the one foot of your Compasse in the one place, and the other foot in the other place, and apply that wideneſſe to the Equinoctiall, and looke how many degrees of the Equinoctial that wideneſſe comprehendeth, and by allowing 60 Italian miles to every degree, you shall have the distance by a right line betwixt those two places, for by doing thus, you shall find the distance betwixt Lisbone and Compostella, to be 120 miles. Thus I have sufficiently (I hope) expounded every thing contained in Plancius his Mappe,

his generall scale made for the same only excepted, whereof I come now to speake. In this scale are set downe the miles of Russia, of Italie, of England, of Scotland, the French leagues, the houre leagues for Mariners, the Spanish leagues, the German and Garscoine miles, which two are all one, the miles of Swevia in Germanie, of Scandia and of Swethland, which last three are likewise all one, the use of which scale is thus. Take with your Compasse the distance betwixt any two places which you desire to know, and apply the same to the scale of such miles as you would know, and so many miles the two places shall be distant one from another as the number of the scale doth shew: but if the distance betwixt the two places be longer then the scale, then having first taken the whole length of the scale with your Compasses looke how many times that widenesse of your Compasse (measuring by a right line) is contained in the distance betwixt the two places, and if there be any odde space left, stretch then your Compasse to that odde space, and apply that to the beginning of the scale, and adde the number of miles which you there find to the first great number, so shall you have the totall sum. And see here for each an example. First suppose that you would know the distance betwixt Cape S. Marie, and Cape finis terræ, which are two Capes or head lands in the West side of Spaine, both having in a manner one selfe longitude, and doe differ only in latitude by 6 degrees, for the one hath 37 and the other 43 in latitude, which distance if you take with your Compasse by setting the one foot in the one place, and the other foot in the other place, and applying that widenesse to the scale of Italian miles, you shall finde the distance to be 390 Italian miles, but if you measure the same distance according to the Geographicall manner, which is to allow for every degree of latitude 60 miles, you shall find the distance to bee no more but 360 Italian miles. Let your other example be thus: Suppose that you would know the distance betwixt Compostella in Spaine and Constantinople, which have all one Latitude and doe differ only in longitude, here because the distance betwixt these two places is longer then the scale, you must take with your Compasses the whole length of the scale, and then to looke

how

how many times that wideneſſe is comprehended (meaſuring by a right line) betwixt the two ſaid places, and you ſhall finde that wideneſſe to be comprehended in the diſtance betwixt thoſe two places three times, wherefore if you multiply 840 by 3, it will make in all 2520 Italian miles. But if (according to the Geographicall kind of meaſuring) you doe multiply the difference of their Longitudes, which is 43 degrées, by the number of miles, which is alſo 43 belonging to the latitude of both places, which latitude alſo is very nigh 43 degrées, you ſhall finde that the diſtance betwixt thoſe two Townes is no more but 1870 Italian miles, which number of miles is not ſo great as that of the ſcale by 650 Italian miles: and therefore I cannot thinke but that there is ſome error in the ſcale, cõmitted either by the Printer or elſe by the Author through ſome negligence, and not for lacke of ſkill or knowledge how to make a true ſcale, being ſo excellent a Geographer, as the Author by this & other his Maps heretofore made, ſheweth himſelfe to be, or elſe there is ſome greater myſterie therein then I perhaps do underſtand, for in ſeeking to know the diſtance betwixt two places differing only in latitude, I find the ſcale moſt times to agrée with the Geographicall kind of meaſuring, but if the two places do differ either in longitude only, or elſe both in longitude and alſo in latitude, then I find the ſcale to differ very much from the Geographicall kind of meaſuring. Wherefore I thinke it good briefly here to ſet downe certaine ready waies of finding out the diſtance of two places, differing either in latitude only, in longitude only, or in both, which I doe ſhew alſo at large in the ſecond part of my Spheare, Chapter 14.

How to find out the diſtance of two places differing only in Latitude.

IF the two places have both either North or South latitude, then ſubtract the leſſer latitude out of the greater, ſo ſhall you have the difference, which difference if you multiply by ſixtie, the product ſhall bee the number of miles, and if to the whole degrees of difference there bee annexed any minutes, then you muſt adde to the product for every minute one mile, but if one of the two places have North Latitude, and the other South Latitude, then you ſhall find their difference by addition, and not by ſubtraction. As for example, ſuppoſe that you would know the diſtance betwixt a Towne called Paſquali, which is the outermoſt Towne in Morea upon the Sea towards the South, having in North Latitude 35 degrees 30', and a certaine Towne in Affrique called Debſan ſtanding nigh unto the lake Zembre, which hath in South latitude 12 degrees 30', here by adding theſe two latitudes together, you ſhall find the ſumme to be 48 degrees, and that is the difference of their Latitudes, which difference if you multiply by 60, the product will be 2880, and that is their diſtance.

How to find out the diſtance of two places differing only in Longitude.

IF both places have either eaſt longitude or weſt longitude then ſubtract the leſſer out of the greater, ſo ſhall you have the difference, which difference you muſt multiply by the number of miles belonging to their latitude, which you ſhall find on the North weſt ſide of the Map, or by the Table of miles anſwerable to one degree of every latitude ſet downe hereafter in the end of this Treatiſe: and the product thereof ſhall bee the number of miles whereby the one place is diſtant

distant from the other. As for example, I find Compostella in Spaine and Constantinople, having both almost 43 degrees of North Latitude, to differ only in East Longitude, for Compostella hath in East Longitude 13 degrees 30′, and Constantinople hath in East Longitude 56 degrees, the difference whereof by subtracting the lesser out of the greater, you shall find to be 42 degrees 30 minuts, here if you multiply 42 by 43 miles belonging to one degree of the foresaid Latitude 43, you shall finde the product to be 1806 then to find out the value of miles for the fraction 30′, by the Rule of proportion, you must say thus: if 60 require 43 miles, what shall 30 require, and you shall finde in the quotient 21 miles, which you must adde to the former Summe 1806, and it will make in all 1827 miles and ½, which is the true distance betwixt the two foresaid places. But if the one place have East Longitude, and the other West Longitude, then you must find the difference as well by addition as by subtraction. As for example, suppose that you would know the distance betwixt S. Domingo in the Ile called Hispaniola, and a certaine place in Affrique called Septem montes, nigh unto the Ocean sea, both places having 18 degrees of North Latitude: And S. Domingo hath in West Longitude 310 degrees 30′. and the place called Septem montes hath in East Longitude 7 degrees. Here you must first subtract 310 degrees 30′ out of 360, degrees, and there will remaine 49 degrees 30′, whereunto you must adde the East Longitude of Septem montes, which is 7 degrees, and it will make in all 56 degrees 30′, which is the difference of their Longitude. Now if you first multiply 56 degrees by 57 miles belonging to 18 degrees of Latitude, you shall find the product to be 3191 miles, and to find out the value of miles for the fraction 30′, you must say thus: If 60 require 57 miles, what shall 30′, require, and working by the Rule of 3, direct, you shall have in the quotient 28 miles, and there remaineth ½ which is one halfe mile. Now by adding 28 miles and ½ to 3192 it will make in all 3220 miles ½, and that is the true distance betwixt S. Domingo and Septem montes, but by Plancius his Mappe you shall find the distance to be 3410 miles, which differeth from the other almost 200 miles.

London,

London.
Hierusalem.
The difference of their longitudes.
Longitude. degrees.
22. o'.
69. o'.
47. o.
Latitude degrees.
51. 32'.
32. o'.
The greater Latit.
The lesser Latit.
A
B
C
D
E
F
G
H
I
K
L
M
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180

How

How to find out the distance of two places differing both in Longitude and Latitude by helpe of a Semi-circle divided into 18 *degrees, which I had from my loving friend Master* Wright *of Caius Collegde in Cambridge, of whom I make mention as well in my Treatise of the Spheare as in that of Navigation.*

FIrst draw a Semi-circle upon a right Diameter, marked with the letters A, B, C, D, whereof let D be the Centre like unto this heere described, and the greater that such a Semi-circle is, the spaces of the degrees shall be the larger, and thereby the more easie to find out the Minutes. When having drawne your Semi-circle, and divided the same accordingly, suppose that by helpe thereof you would find out the distance betwixt London and Hierusalem, which two Townes doe differ both in longitude, and also in latitude so much as is heere set downe in the front of the Figure, according to such longitude and latitude as Plancius doth allow to either Towne in his great Mappe. Now to find out the true distance of these two Townes, you must first take the lesser Longitude out of the greater, so shall you have the difference of their Longitudes, which is 47 degrees, then count that difference upon the Semi-circle, beginning at A, and so proceed to B, and at the end of that difference, make a pricke marked with the letter E, unto which pricke draw a right line by your Ruler from D, the Centre of the Semi-circle that done, seeke out the lesser Latitude, which is 32 degrees o', in the foresaid Semi-circle, beginning to account the same from the pricke E, and so proceed towards the letter B, and at the end of the said lesser Latitude set downe another pricke marked with the letter G, from which pricke or point draw a perpendicular line, which by helpe of your squire or compasses, may fal with right Angles upon the former right line drawne from D to E, and where it falleth, there set downe a pricke marked with the letter H, that done, seeke

out

out the greater Latitude which is 51 degrees and 32' in the foresaid Semicircle, beginning to account the same from A towards B, and at the end of that Latitude set downe another pricke marked with the letter I, from whence draw another perpendicular line that may fall by helpe of your squire or compasses, with right angles upon the Diameter, A, C, and there make a pricke marked with the Letter K, that done, take with your Compasse the distance that is betwixt K, and H, which distance you must set downe upon the said Diameter A, C, setting the one foot of your Compasse upon K, and the other towards the Centre D, and there make a prick marked with the letter L, then take with your compasse the length of the shorter perpendicular line G, H, and apply that wideneſſe upon the longer perpendicular line I, K, setting the one foot of your Compasse at I, which is the end of the greater Latitude, and extend the other foot towards K, and there make a pricke marked with the letter M, That done take the distance betwixt L, and M, with your Compasse, and apply the same to the Semicircle, setting the one foot of your Compasse on A, and the other towards B, and there make a pricke marked with the letter N, and the number of degrees contained betwixt A, and N, will shew the true distance of the two places which you shall find to be 39 degrees, which being multiplied by 60, maketh in all 2340 miles, and whensoever you have any minutes besides the whole degrees, remember to adde unto the summe of degrees for every minute one mile. By Plancius scale you shall find the distance betwixt London and Hierusalem to be 3040 miles which are 700 Miles too many. But you have to note by the way, that if the difference of the Longitudes doe exceed the number of 180, then you must subtract that exceeding difference out of 360, & the remainder shall be the difference of the Longitudes, and then worke in all points as is before taught.

By this Rule and the other two Rules first declared, you shall easily trie the scale of any Mappe whether it be true or not, so as you first have the true Longitude and Latitude of the two places whose distance you seeke to know. And thus I end with Plancius Map, hoping not to offend him with any thing that I

have

haue added thereunto for the better instruction of those that haue not béene exercised in such matters.

And yet I had almost forgotten one thing, which is this, I haue héere before as you haue read, made mention of drawing certaine perpendicular lines in the former figure of the Semicircle, by helpe of your Compasses. Wherefore I thinke it necessarie héere to set downe the order thereof.

How to make with your Compasses a perpendicular line to fall from any point giuen vpon another right line, making therewith right Angles without the helpe of any squire.

SEt the firme foote of your Compasse in the point giuen, and extend the other foote a little beyond the line right against the point giuen, and draw a secret Arch or portion of a Circle that may cut the said line in two points, and diuide that part of the Arch which lieth betwixt the two sections into two equall parts setting a pricke in the very midst thereof: then hauing laid your rule to that pricke, and also to the point giuen, draw a right line, and that line will fall vpon the other line with right Angles, as you may sée by this figure.

The

The Table of miles anſwerable to the degree of euery ſeuerall Latitude.

D	M	S	D	M	S	D	M	S	D	M	S	D	M	S
1	59	59	19	56	44	37	47	55	55	24	15	73	17	22
2	59	58	20	56	23	38	47	17	56	23	43	74	16	32
3	59	56	21	56	1	39	46	38	57	22	41	75	15	22
4	59	53	22	55	38	40	45	58	58	21	48	76	14	31
5	59	49	23	55	14	41	45	17	59	20	54	77	13	30
6	59	46	24	54	49	42	44	35	60	20	0	78	12	28
7	59	42	25	54	23	43	43	52	61	19	5	79	11	27
8	59	35	26	53	56	44	43	10	62	18	10	80	10	25
9	59	16	27	53	28	45	42	30	63	17	14	81	9	23
10	59	5	28	52	59	46	41	41	64	16	18	82	8	21
11	58	54	29	52	29	47	40	55	65	15	21	83	7	19
12	58	41	30	51	58	48	40	9	66	14	24	84	6	16
13	58	28	31	51	26	49	39	22	67	13	27	85	5	14
14	58	13	32	50	53	50	38	34	68	12	29	86	4	11
15	57	57	33	50	15	51	37	45	69	11	30	87	3	8
16	57	41	34	49	45	52	36	56	70	10	31	88	2	5
17	57	23	35	49	5	53	36	7	71	9	32	89	1	3
18	57	4	36	48	32	54	35	16	72	8	32	90	0	0

Though it be the common order of working, to know by helpe of the former Table the diſtance of two places differing onely in Longitude, yet I thinke it a more ſure way to finde it out Per Tabulas Sinuum, the rule whereof is thus

First

First take the difference of the two Longitudes, by subtracting the lesser out of the greater, and the halfe of that shall be the Arch, which you haue to seeke in the front of the Tables, then multiply the signe of that Arch by the signe of the complement of the common Latitude, and diuide the product thereof by the totall signe, the quotient whereof you must seeke out in the Tables among the signes, and the Arch of that signe is the one halfe of the distance, which being doubled shall be the whole distance containing degrees of the great Circle, and euery such degree containeth of Italian miles 60. and of Germaine miles 15. and by working thus you shall finde the distance betwixt Compostella and Constantinople to be 1846. Italian miles, supposing the common Latitude to bee 43. degrees, and the difference of their Longitudes to bee 42. degrees 30. And by working by the common Table you shall finde the distance of those two places to be 1827. Italian miles as before, because the common Table hath no minutes of miles but onely seconds, which are not to bee accounted of, and in working by Appian his Table hauing minutes of miles, you shal find the said distance to be 1892. Italian miles, and by Mercator his Map to bee 1980. Italian miles, in whose Map, the common Latitude of the said 2. places is 43. and the difference of their Longitudes is 44. 0'. And by the scale set downe in Plancius his Map, you shall find the distance to bee 2520. Italian miles, in which Map the common Latitude of the two foresaid places is 42. degr. 30. & the difference of their Longitudes is also 42. degrees 30'. Truly I must néeds confesse that it is not so easie to make a scale or trunke for a Map or a Card drawne in Plano as for that which is drawne vpon a round body or Globe, and therfore it is no maruell though the scales of Maps drawne in Plano, and likewise the trunks set downe in the Mariners Cards, doe not alwaies shew the true distance of places, which I beleeue is to be done as truly and a great deale more readily by my friend Master Wright his Semi-circle before described, then by the rules of Gasparus Peucerus in his booke de dimensione terræ which rules doe depend vpon the knowledge of the quantitie of the Angles and sides of Spherical Triangles

which

which kinde of working is indeed more troublesome and tedious then ready or pleasant. But if Master Wright would make his Semicircle an vniuersall Instrument to finde out thereby all the three kindes of distances as he promised me to do, there were no way in mine opinion worthie to be compared vnto it, neither for the trueneſſe, easinesſe, nor readineſſe of working thereby.

A Very briefe and moſt plaine Deſcription of Mr BLAGRAVE his *Aſtrolabe*, which he calleth the *Mathematicall Iewell*.

Together with divers Vſes thereof, moſt neceſſary for Sea-men.

Written by Mr. BLUNDEVILL.



LONDON,
Printed by *Richard Biſhop*. 1636.

A

Very brief and moſt plain Deſcription of Mr

which he calleth the Ma-

together with divers Views thereof,
moſt neceſſary for Seamen.

To the Reader.

OF Astrolabes I have never seen but three sorts, First, that of *Stoefflerus*, which for these hundred yeeres past or thereabouts hath beene had in most price and estimation, as an instrument containing all the uses, or at the least the most part of all other Mathematicall Instruments, which because it requireth almost for every severall Latitude a severall Table, *Gemma Frisius* invented since another kind of Astrolabe, having but one Table to serve for all Latitudes, and therefore he called it the *Catholicon*, that is to say, an universall Astrolabe, which hath also beene most esteemed and used many yeeres. Since whose time, and of very late yeeres, one of our owne countrimen a Gentleman of *Reading* besides *London*, called M. *Blagrave*, hath greatly augmented the said *Catholicon*, and hath thereby as it were newly invented a third kind of Astrolabe, which he calleth the *Mathematicall Iewell*, whereby are to bee wrought more conclusions than by any other one Instrument whatsoever, for which his most excellent invention used therein he deserveth great commendation. And to the intent that others which have not beene exercised in such things, might the more easily attaine to the better understanding of the said Iewell, I have made a plain description of all the parts belonging to the said Iewell: without committing any offence (I hope) to the Author thereof, to the intent that every Gentleman might have the perfect knowledge and use of so worthy an Instrument. But broad Astrolabes, though they bee thereby the truer, yet for that they are subject to the force of the wind, and thereby ever moving and unstable, are nothing meet to take the Altitude of any thing, and especially upon the Sea,

which thing to avoyd, the Spaniards do commonly make their Aſtrolabes or Rings narrow and weighty, which for the moſt part are not much above five inches broad, and yet do weigh at the leaſt foure pound, and to that end the lower part is made a great deale thicker than the upper part towards the ring or handle. Notwithſtanding moſt of our Engliſh Pilots that bee skilfull, do make their Sea Aſtrolabes or Rings ſix or ſeven inches broad, and therewith very maſſive and heavie, not eaſie to be moved with every wind, in which the ſpaces of the degrees be the larger, and thereby the truer, of which kind of Aſtrolabes or Rings I ſhall ſpeake hereafter in my Treatiſe of Navigation, and alſo of the Mariners Croſſe-ſtaffe. But whenſoever you have to take the Altiude of the Sunne, or of any other ſtarre, bee it wandring or fixed, I would wiſh you to uſe the Mariners heavy and maſſive Aſtrolabe which in mine opinion for that purpoſe is the fitteſt and moſt aſſured Inſtrument of all others; and to find out all other concluſions by helpe of M. *Blagrave* his Iewell, or rather by helpe of the Celeſtiall Globe, which for Aſtronomicall matters is the perfecteſt Inſtrument of all, in which are contained all the ſtarres both Southerne and Northerne that have beene heretofore knowne; and thoſe that are lately knowne, or ſhall be knowne hereafter, may be eaſily placed therein: which thing cannot be ſo well performed in any Aſtrolabe, were it never ſo great. But becauſe the Globe is comberſome and not portable, and therewith coſtly, and eſpecially if it be of any greatneſſe (for the greater the better) and alſo if it chance to bee broken in any part of the body thereof, it can never be made againe perfectly whole, it is therefore no meet Inſtrument for every Mariner to have, but only for ſuch as be of good ability, inſteed whereof to find out many neceſſary concluſions, Maſter *Blagrave* his Mathematicall Iewell may ſerve very well, and eſpecially if it had on the back part the like Mater and *Rete* or Net, to ſerve the South Latitude of the world, as it hath in the fore part to ſerve the North Latitude: for then I beleeve verily, that the chiefeſt Southerne ſtarres, as the Croſſe, the Southerne Triangle, *Noahs* Dove or Pigion, and another called Polophilax, lately found out by ſuch as have travelled by Sea oo the

South

South side of the Equinoctiall, might easily be placed by M. *Blagrave* in that *Rete*, having once learned of the skilfull Seamen the true longitude, latitude, and declination of the starres, so should his Iewell in mine opinion be much more serviceable to the Sea-men, than now it is, by reason that those few Southern stars that be contained in the first Net, are nothing so nigh unto the South Pole, as the Northerne stars, described in his first Net, are unto the North Pole, amongst which Northerne stars, it were very necessary for the Sea-men, that the seven principall starres as well of the great Beare, as of the little Beare, were all duly placed in his first Nette. Truly if Master *Blagrave* his affaires would suffer him to take paine herein, I beleeve that his Iewell should not be much inferiour to the Celestiall Globe, which indeed it repreresenteth, and in so doing hee should greatly profit the Seamen, and deserve thereby great good will and commendations at their hands.

What this word Astrolabe *signifieth.*

BEfore I begin to describe unto you the said Instrument, and all other parts thereof, it shall not bee amisse to shew you what this word Astrolabe signifieth.

This word Astrolabe is as much to say as the handle or Instrument of the starres, by helpe whereof the manifold motions and apparances of the heavens and of the starres therein contained, are knowne, and it is called of some a Planisphere, because it is both flat and round, representing the Globe or Spheare, having both his Poles clapt flat together: the shape or figure of which Instrument I do not here set down, because the Instrument it selfe is to be had for a small price in divers places of *London*, which if you lay before you when you mind to read this my description therof here following, I doubt not but that you shall finde every part thereof so plainly explained, as you shall need no other teacher to instruct you therein, or to helpe you to understand any of these Conclusions that are to be wrought by that Instrument, and especially those which I have here set downe, such as the Table following sheweth, and as I thought most meet for Sea-men to know, and being throughly exercised in them, you shall the more easily understand the manifold and necessary Conclusions set down by M. *Blagrave* himselfe in his own book, which book I would wish you to buy, and earnestly to study the same. But now I will first describe the said Instrument, and then shew the use thereof by so many Conclusions as are contained in the Table hereafter following.

The

The description of Master *Blagraue* his ASTROLABE, otherwise called the MATHEMATICALL IEWELL.

THis Astrolabe is diuided into two parts, whereof the one is called the fixe part, and the other the back part. The fore part containeth two principall parts, that is, the Mater, which is vnmouable, and the Rete, which is moueable. Againe, the Mater is enuironed with a great Circle, called the Meridian, passing thorow the right poles of the world marked with the letters A, B, and thorow the two Solsticiall points of Cancer and Capricorne marked with the Characters belonging to those two signes, and therefore may very well be called the Colure of the two Solstices. And this Circle is diuided by two crosse Diameters into foure quarters, euery quarter containing 90 degrees, so as the whole Circumference of the Circle is 360 degrees, which degrees do procede from 90 to 90.

Now as touching the two crosse Diameters, the one passing thorow the Center, and also thorow the two Poles, vnto the Arctike of the world, signifying sometime the first Meridian, and sometime the right Horizon, and sometime the line of six houres as well for the Morning as Euening, and then it is the line of East and West, and sometime the line of North and South.

And the other crosse Diameter drawne with red Inke, signifieth most commonly the Equinoctiall, and sometime the line of

East and West, and sometime the line of the North and South, and especially when you have to finde out the 12 houres of heaven, to which ends are set down in the outermost Meridian these foure Latine words, first at the North Pole marked with the letter A, Oriens, which is as much to say as the East part: and at the South Pole marked with the letter B, Occidens, which signifieth the West part: and at the end of the overthwart Diameter, drawne with red Inke, & most commonly signifying the Equinoctiall, marked with the letter C, on the right hand is set downe Culmen Cœli, the highest part of heaven, which is the South, at which end the ring or handle is fastned. And at the other end of the said Diameter, marked on the left hand with the letter D, is set downe Imum Cœli, the lowest part of heaven, which is the North. And by these two crosse Diameters the whole Mater is divided into foure quarters, that is, Northeast and Southeast, Northwest and Southwest. The Northeast quarter lieth betwixt Imum Cœli, and the upper end of the Axeltree, whereon is written Oriens. And the Southeast quarter lieth betwixt the same point and Culmen Cœli, and the Southwest quarter lieth betwixt Culmen Cœli, and the lower end of the Axeltree, whereon is written Occidens, and the Northeast quarter lieth betwixt the point Occidens and Imum Cœli.

The Meridians and houre lines to the Mater.

Besides these two crosse Diameters the Mater is traced with 180 Meridians, which do passe thorow both the Poles, whereof the first passing thorow the Center from Pole to Pole is the Colure of the Equinoxes, because it passeth thorow the first point of Aries, and the first point of Libra, and is otherwise called the Axeltree, and signifieth sometime the right Horizon, & sometime the first Meridian, from which upon the Equinoctiall are counted the degrees of longitude both East and West. And all the foresaid Meridians are most commonly used as houre-lines: for every 15 Meridian, counting from the Limbe, doth signifie one houre, for 15 degrees do make an houre, and 4 minutes do make a degree. And these houres at the end of every 15 Meridian are marked in the body of the Mater somewhat above the Tropique of Cancer with Arithmetical figures, proceeding from one to 12 forward towards the right hand, and againe are marked somewhat

somewhat beneath the Tropique of Capricorne with like figures, proceeding backward towards the left hand. Wherof the upper numbers do signifie the forenoone houres, and the lower numbers the afternoone houres, and are placed so as one selfe houre-line doth passe thorow both numbers: for the line of the eleventh houre in the forenoone serveth also to the first houre in the afternoone, and the forenoone houre of 10, serveth also to the houre of two in the afternoone, and the forenoone of 9, serveth to the houre of 3 in the afternoone: and the forenoone houre of 8 serveth to the houre of 4 in the afternoone, and the forenoone houre of 7 serveth to the houre of 5 in the afternoone, and the forenoon houre of 6 serveth also to the 6 houre in the afternoon: and from thence forth towards the left hand, 5 serveth to 7, 4 to 8, 3 to 9, 2 to 10, and 1 to 11, as before.

But whensoever you have to finde out any houre amongst the houre-lines in the Mater, remember that the Arctike which passeth thorow the Center, and also thorow both the Poles, is allwayes the first houre both of the Morning and Evening, from which you shall the more easily finde out any houre that you seeke, by allowing fifteene Meridians to every houre, as is before said. And you have to note that all these Meridians do sometime signifie every one a severall oblique Horizon, saving that the first Meridian or Arctike signifieth the right Horizon as hath beene said before. And to finde out in the Mater the Horizon of every latitude, reckon from the Arctike on both hands so many Meridians as may make up the number of degrees of your latitude, and that Meridian shalbe your Horizon. In counting of which Meridians you shal finde that every fift Meridian is drawne with a greater black line than the rest. How overthwart these Meridians are drawne 180 Parallels, which proceed from 1 to 90, whose numbers are set downe in the Limbe of the Mater thus, 10, 20, 30, 40, and so forth both upward and downward, untill you come to 90, and these Parallels are otherwise called the Circles of declination as well of the Sun as of any Star. Amongst which there be 2 Parallels painted red, wherof that towards the North Pole signifieth the Tropique of Cancer, and the other towards the South Pole the Tropique of Capricorne.

How to finde out the Horizon of every severall latitude.

The Parallels of the Mater.

The two Tropiques.

pricorne. Then there is an other oblique ouerthwart red line, which passing thorow the Center from Tropique to Tropique, signifieth the Ecliptique line, nigh unto which on each side are set downe the Characters of the twelue signes, whereof Aries and Libra are placed at the Center, and Cancer at the one end of the Ecliptique on your right hand, whereas it toucheth the said Tropique, and Capricorne, at the other end of the said Ecliptique on your left hand, whereas it toucheth the said Tropique of Capricorne, and the rest of the signes are orderly placed betwixt the said Tropiques, every two signes one against another that haue like declination, as Gemini and Leo, Taurus and Virgo, which are placed betwixt the Center and Cancer, then Pisces and Scorpio, Aquarius and Sagittarius are placed betwixt the Center and Capricorne. And every signe contained in the Ecliptique line is diuided with slanting blach strokes into 15 spaces, every space containing two degrees, which maketh 180 degrees, and being doubled, because the spaces are to be counted both forward and backward, do make in all 360 degrees, which is the whole circuit or longitude of the Ecliptique, and the degrees of the said Ecliptique are larger towards the Limbe than towards the Center, whereby the spaces betwixt signe and signe are not equall, but some larger than other some.

The Ecliptick line of the Mater.

The Limbe of the Mater.

And note, that upon the outermost Limbe of the Mater are drawn three Circles making two reasonable spaces, both which spaces are diuided into 360 degrees, both of them beginning at the North Pole. And the degrees in the outermost space of the Limbe beginning at the North Pole do proceed from 15 to 15, downward towards your left hand, and so round about the Instrument untill you come to 360, which degrees do shew the houres of the Equinoctiall. And at the North Pole, whereas the diuision beginneth, is set downe the figure of 6, signifying the first houre of the forenoone, then counting 15 deg. downward towards your left hand is set downe in the foresaid space the figure of 5, then 4, 3, 2, and 1. And at the end of the Equinoctiall on the left hand is set downe 12, from which proceeding still downwards are set these numbers of houres, 11, 10, 9, 8, 7, and 6, which 6 standeth at the South Pole, then from thence proceeding

ding upwards are set downe these houres 6,5,4,3,2,1, and then 12, which standeth at the end of the Equinoctiall on the right hand, from whence proceeding still upwards towards the North Pole, are set downe these houres, 11,10,9,8 and 7, and at the Pole it selfe is set downe the figure of 6, as before hath beene said, from whence you first beganne to count. And in the inner space of the same Limbe, the 360 degrees are to be counted by 90, in such sort as the first 90 is placed at the North Pole, the second 90 at the one end of the Equinoctiall marked with C, the third 90 at the South Pole marked with B, and the fourth 90 at the other end of the Equinoctiall marked with D. Every which quarter is to be counted both upward and downward, according as you see the numbers written with Arithmeticall figures, and are placed one above another in the said space, whereof the upper figures are somewhat lesser than the nether figures, both of them proceeding from 1 to 90, the greater figures from the Equinoctiall upward to the very Pole, and the lesser figures from the Pole downward to the Equinoctiall, and are thus set downe: 10, 20, 30, 40.

A description of the Nette, called in Latine Rete.

This part is first inuironed round about with a great Circle signifying most commonly the Meridian or 90 Azimuth or Verticall Circle, and sometime it signifieth the Equinoctiall, and especially when the Center is taken for the Pole, which Circle is divided by two crosse Diameters into foure quarters, every quarter containing 90 degrees, which degrees are to bee numbred in the very Limbe of the Rete both upward and downward, and of these two crosse Diameters, the one end marked with the letter A, signifieth the Zenith, and the other end marked with the letter B, signifieth the Nadir or point opposite, and the

the other Crosse Diameter marked with the letters C, D, signifieth the Horizon, which for distinctions sake is otherwise called the Finitor, because the Meridians before described in the Rete are to be cosled and used sometimes as Horizons, and this Finitor is a pretty broad Ruler, the very edge whereof is divided with small divisions into 180 degrees, which being doubled by reckoning the same both forward and backward, (beginning at the Center) do make up three hundred and threescore degrees.

The Finitor. This Finitor signifieth the Horizon of the Globe, the very edge whereof being divided by little short strokes into small portions or degrees, is alwayes to be applied to any severall latitude when need is, and the broader part thereof serveth only to containe the numbers that are set therein both beneath and above, to know thereby the number of every Azimuth hereafter described, which numbers do proceed from the Center to the right hand thus: 10, 20, 30, 40, 50, and so forth to 90. Then backward towards the Center are set downe 100, 110, 120, 130 140, and so forth untill you come to 180, which is placed at the very Center. Then from thence towards the left hand are set downe these numbers, 190, 200, 210, and so forth untill you come to 270, and from thence turning againe towards the Center are set downe 280, 290, and so forth untill you come to 360 placed at the Center.

The Almicanterats. And in the said Rete are certaine Circles, which are Parallels to the foresaid Finitor, proceeding towards the Zenith, and are in every respect like unto the Parallels described in the Rete, and these Parallels are called Almicanterats, that is to say, Circles of Altitude, which beginning at the Finitor do proceed to the Zenith, marked with the letter A from 1 to 90. And though there be cut out in the Rete but 30 Almicanterats, yet forsomuch as every space contained betwixt every 3 Almicanterats do containe 3 degrees, they make in all 90, for 3 times 30 maketh 90, which degrees you may see set downe in the Limbe of the Rete on both hands thus: 10, 20, 30, and so forth, till you come to 90, which endeth at the very Zenith.

The Azimuths And these Almicanterats are crossed with other Circles called Azimuths,

Azimuthes, that is to say, Verticall Circles, which passing from the Finitor, do meet all in the Zenith, whereof though in this Instrument there be set downe but 12, being 15 degrees distant one from another, yet you must imagine that there bee 180, which the degrees set downe in the Finitor in such manner as is before described, do shew. And you have to note, that if the Sun be in the very beginning of the Azimuthes, which is at the Center, then he is full East, and if he be in the 90 Azimuth, then hee is full South, and when hee is in the 180, then he is full West, and when he is in the 270 Azimuth, then he is full North.

And if you would have this account of the Azimuthes to answer the Mariners Compasse, then divide the number of the Azimuths wherein the Sun is by 11 degrees $\frac{1}{4}$ which is 15', and the Quotient will shew the Rumb or Wind of the Mariners Compasse, so as in your account you proceed from the first Azimuth towards your right hand, that is, from East to South, and from South to West, and from West to North, & so from thence again to the East point wheras you first began. Also you have to note by the way, that these Azimuths do sometime signifie the Circles of position, the use whereof you shall finde set downe hereafter in the 31 proposition of this Treatise. How to count the Azimuths according to the Mariners Compasse.

In the mean time I will proceed in describing the Zodiaque of the Rete, which in shape is like an Egge, called in Latin Figura ovalis, the one halfe whereof extendeth towards the Zenith, and the other towards the Nadir or point opposite to the said Zenith in which Circle are placed 12 signes, whereof the 6 Northerne signes, that is, Aries, Taurus, Gemini, Cancer, Leo, and Virgo, are placed in the nether halfe towards the Nadir. And the other 6 Southerne signes, that is, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, and Pisces, are placed in the upper halfe of the Zodiaque towards the Zenith, and every one of these signes are divided into 30 degrees, which are set downe with Arithmeticall Figures in the said Zodiaque thus: 10. 20. 30. The description of the Zodiaque of the Rete.

Moreover, in th said Net are placed certaine fired starres to the number of 71, whose names do here follow. Caput Ophinci, that is, the head of Serpentarius. Aquila, the Eagle. Caput Engon, Of 71. Starres contained in the Rete.

gon, the head of Hercules. Cuſpis Sagittarii, the ſhaft of Sagittarius. Palma Ophinci, the hand of Serpentarius. Cauda Delphini, the tayle of the Dolphin. Romboides Delphini, which is a ſtar in the Dolphins backe. Cor Scorpionis, the heart of the Scorpion. Frons Borealis, Media, and Auſtralis Scorpionis, the Northerne, Southerne, and middle front of Scorpio. Lucida Lyræ, the bright ſtarre of Lyra, or Vultur cadens. Lanx Chelæ Borealis, & Auſtralis, the North and South ſtarre of the Balance. Corona Gnoſiæ, the Crowne of Ariadna. Præcedens & ſequens caudæ Capricorni, that is, the former and follower in the tayle of Capricorne. Caput Draconis, the head of the Dragon. Haſtile Bootis, the Bore-ſpeare of Arcturus. Cauda Cygni, the taile of the Swanne. Fomahand, a ſtarre in the mouth of the Southerne Fiſh. Arcturus, a ſtarre betwixt the legges of Bubulcus or Bootes. Humerus Bootis, the ſhoulder of Bubulcus. Dexter Humerus Cephei, the right ſhoulder of Cepheus. Crus Pegaſi, the legge of the winged Horſe. Spica Virginis, the Wheat eare in the hand of Virgo. Tres ſtellæ in cauda Vrſæ majoris, three ſtars in the tayle of the great Beare. Previndemiatrix, that is, Virgo. Cauda Ceti, the tayle of the Whale. Andromedæ Scapulum, the ſhoulder blade of Andromeda. Cingulum Andromedæ, the girdle of Andromeda. Humerus Vrſæ majoris, the ſhoulder of the great Beare. Corvi roſtrum, the beake of the Crow. Corvi ala dextra, the right wing of the Crow. Cauda Leonis, the tayle of the Lyon. Cervix Leonis, the necke of the Lyon. Cor Leonis, the heart of the Lyon, otherwiſe called Regulus. Lucida Hydræ, the bright ſtarre of Hydra. Capita Geminorum, the heads of the two Twinnes named Apollo and Hercules. Cancer, the Crabbe. Canis minor, the little Dogge. Canis major, the great Dogge. Canopus, a faire ſtar in the left oare of the ſhip Argus. Humerus dexter Aurigæ, the right ſhoulder of Auriga. Hircus, the Goat hanging at the backe of Auriga. Hedi, the two little Goats ſucking behind at her paps. Humerus dexter Orionis, the right ſhoulder of Orion. Tres ſtellæ in cingulo Orionis three ſtarres in the girdle of Orion. Humerus ſiniſter Orionis, the left ſhoulder of Orion. Pes ſiniſter Orionis, the left foot of Orion. Oculus Tauri, the Bull's eye.

Pleiades

Pleiades, the seuen little starres in the Bull's necke. Extremum Eridani, the last end of the fine Eridanus. Caput Medusæ, the head of Medusa. Dextrum latus Persei, the right shoulder of Perseus. Cornu Arietis, the former starre of the Rams horne. Venter Ceti, the belly of the Whale. Iuba Ceti, the mane of the Whale.

And note that all these starres in the Nette, whose longest tippes or points do point from the Center outward towards the Limbe, are Northerne starres having North declination, and those whose longest tips do point inward from the Limbe towards the Center, are Southerne starres, having Southern declination. All which starres are set downe in a Table in the beginning of the third booke, which doth not only shew their names, but also their Longitudes, Latitudes, and declinations, their natures, their right Ascentions and Magnitudes, or greatnesse. And whereas both in the Mater, and also in the Rete, one selfe Circle is made to have divers significations, the cause thereof shall plainly appeare unto you by the use of the Astrolabe, in seeking to finde out thereby the Propositions of the foresaid booke. How to know which starres be North or South.

And besides the parts before described, there is yet another part belonging to the forepart of the Instrument, called the Label, the one end whereof is fastned to the Center of the Astrolabe, so as it may turne round about. And this Label is divided into 90 degrees twice set downe therein with Arithmeticall figures, to be reckoned as well from the Center to the point of the Label, as from the point thereof to the Center, serving to divers uses, yea the 90 degrees of the Label are sometimes to be repeated foure times to make up the number of 360 degrees, as shall hereafter plainly appeare by the 12 Proposition, shewing how to finde out the right Ascention of any degree or portion of the Ecliptique line. A description of the Label.

And remember that the right line drawne from the Center of the Label alongst the inward edge thereof is called the Fiduciall line, and is divided into 90 small parts called degrees, which line or inward edge is alwayes to be used in any Proposition, and not the outward edge or back part of the Label. The fiduciall line of the Label.

Thus

Thus much touching the former part of M. Blagrave his Iewel, with every particular part thereof, with which former part I wish you to be throughly acquainted before you deale with the Propositions here following, or with any other Proposition contained in M. Blagrave his Booke.

A briefe description of the backe part of the said Iewell.

IN the Limbe of the backe part is described the Theorique of the Sun, to know thereby in what signe and degree the Sun is every day throughout the yeere, by laying the Diopter thereto. M. Blagrave calleth it a Ruler, which Diopter is made with two Pinules or square Tablets, each one pierced with two holes, one greater than another, the lesser to take the height of the Sun by his beame passing thorow the said lesser holes, and the greater holes do serve to take the Altitude of the Sun, being somewhat darkned in the day time, so as he casteth no beame, or else the Altitude of any Star in the night season by looking with your one eye, the other being shut, thorow the two greater holes of the Pinules or Tablets. And the middest of this Diopter is fastned with a pinne to the Center of the Astrolabe, so as the said Diopter may turne round about, and the middle line of the said Diopter is called the fiduciall line, because it rightly directeth the sight of the eye to the foresaid holes. The degrees of the altitude of the Sun or of any Star are set downe in the outermost space of the Limbe, divided by 2 crosse Diameters into foure quarters, every quarter containing 90 degrees, the number of which degrees are set downe in the outermost space of the Limbe of the said back part with Arithmetical figures, right over the heads of the said degrees of altitude. And you have to note, that the perpendicular Diameter signifieth the Meridian, that is, the line of South and North, that is to say, the South point at the ring or handle, and the North

at

at the point opposite, and the other ouerthwart Diameter signifieth the right Horizon, that is to say, the line of the East and West, the East being placed on the left hand, and the West on the right hand. And under the Theorique of the Sunne, you may draw as many Circles of such reasonable distance one from another, as in the spaces thereof may be set downe the yeeres of our Lord, the Dominicall letter for the leape yeere, and the Dominicall letter for the common yeares, the Prime or Golden number, the Epact, and on what day of March or of Aprill, Easter day every yeare falleth, in such order as Master Balgrave hath himself described in a Table made of purpose in the second booke of his Iewell, the 17 Chapter.

Thus having described euery particular thing, as well in the forepart as in the backpart of the said Instrument, I will now shew you how to use the same, and how to finde out thereby all the conclusions contained in the Table heere next following.

The Table containing 32 necessary Conclusions to be wrought by this Astrolabe.

FIrst how to finde out the place of the Sunne (that is to say) in what signe and degree thereof the Sunne is every day throughout the yeere, being not leape yeere, and also the opposite point of that degree. Proposition 1.

How to know the place of the Sunne in the leape yeare, and how to finde the leape yeare. Prop. 2.

How to take the Altitude of the Sunne or of any starre. Prop. 3

How to take the Meridian Altitude, that is to say, the highest or greatest Altitude of the Sunne or any starre. Prop. 4.

How to know the Altitude of the Sunne at any houre without seeing the Sunne. Prop. 5.

How to know the Meridian Altitude of the Sun, or of any star in the Net without seeing them. Prop. 6.

How to know the declination of the Sunne, or of any ſtarre contained in the Net. Prop. 7.

How to finde out the Latitude of any Region diuers waies. Prop. 8.

How to know the houre of the day by the Sun, and alſo in what part or coaſt of heauen he is at that inſtant. Prop. 9.

How to finde the riſing and ſetting of the Sunne euery day in euery Latitude, and thereby the length of the day, and alſo in what coaſt or part of the Horizon he riſeth and ſetteth. Prop. 10.

How to know euery day at what houre the Moone riſeth and ſetteth, and how long ſhe continueth aboue the Horizon, and alſo when ſhe is full South. Prop. 11.

How to finde out the right aſcention of the Sunne, or of any degree or portion of the Ecliptique. Prop. 12.

Another more readie way to finde out the right aſcention of any degree or portion of the Ecliptique by the Rete. Prop. 13.

How to finde out the aſcentionall difference of the Sunne, or of any degree or point of the Ecliptique. Prop. 14.

How to finde out the oblique aſcention of the Sunne, or of any point of the Ecliptique. Prop. 15.

How to finde out the right aſcention of any Arke or portion of the Ecliptique, and therewith to know what time it ſpendeth in riſing in a right Spheare. Prop. 16.

How to finde out the oblique aſcention of any Arke of the Ecliptique in any Latitude, and what time it ſpendeth in his riſing. Prop. 17.

How to finde out the oblique deſcention of any point of the Ecliptique in any Latitude. Prop. 18.

How to finde out the oblique deſcention of any Arke giuen of the Ecliptique, and therewith to know the time that it ſpendeth in his ſetting. Prop. 19.

How to know the height of any ſtarre at any houre without ſeeing the ſtarre, and thereby to finde out in the firmament all the ſtarres that be deſcribed in the Net, and are to be ſeene with the eye. Prop. 20.

How to finde out the aſcentionall difference of any ſtarre. Prop. 21.

How to know the oblique aſcention of any ſtarre. Prop. 22.

How to know what ſtarres doe neuer riſe nor ſet in any Latitude. Prop. 23.

How to know at what houre of the day or night any ſtarre riſeth or ſetteth. Prop. 24.

How to know how long any ſtarre continueth aboue the Horizon in euery Latitude. Prop. 25.

How to finde out the ſtarres houre, and thereby to know the houre of the night. Prop. 26.

How to finde out the diſtance betwixt any two ſtarres contained in the Net. Prop. 27.

Another way to know the diſtance of any two ſtarres, their Longitudes and Latitudes being firſt knowne, and alſo by that meanes to finde out the diſtance betwixt any two places vpon the earth. Prop. 28.

How to finde out the degree of *Medium cœli* at any houre of the day, that is to ſay, the degree of the Zodiaque that is in the Meridian at any houre that you ſeeke, and alſo the degree called *Imum cœli*. Prop. 29.

How to finde out the Horoſcope or aſcendent at any time of the day or night, and thereby to haue the foure principall Angles of heauen. Prop. 30.

How to finde the Circles of poſition, and to know how much the Pole is eleuated aboue euery ſuch Circle in any Latitude, without the knowledge whereof you cannot finde out the 12. houſes by this Aſtrolabe. Prop. 31.

How to finde out all the 12. houſes of heauen, and thereby to erect a figure at any houre of the day or night. Prop. 32.

Proposition. I.

The uſes of the Aſtrolabe, and firſt how to find out the place of the Sunne (that is to ſay) in what ſigne and degree thereof the Sunne is every day throughout the yeare, being not lape yeare, and alſo the oppoſite point of that degree.

LAy the Diopter which is on the backſide of the Aſtrolabe, upon the day of the month, and that end of the Diopter with his fiduciall line will ſhew you in what ſigne and degree thereof the Sunne is that day, and the other end of the Diopter will ſhew you the oppoſite point to that degree. As for example, I would know the place of the Sunne the 17 of July, here by laying the Diopter upon that day, I finde the Sunne to bee in the fourth degree of Leo, and the oppoſite point thereof to be the fourth degree of Aquarius.

Proposition. II.

How to know the place of the Sunne in the leape yeare, and how to finde the leape yeare.

WHen it is leape yeare you muſt alwaies adde one degree more every day during that yeare vnto the place of the Sunne found by the firſt Propoſition, which leape yeare you ſhall know by diuiding the yeare of our Lord by 4, for if there bee no remainder left, then that yeare is leape yeare, ſo ſhall you finde the yeare of our Lord 1596. the leape yeare.

How

Proposition. III.

How to take the Altitude of the Sunne, or of any ſtarre.

TO take the Altitude in any time of the day when the Sun ſhineth, you muſt turne your face and alſo the left Tablet or Pinule of the Diopter towards the Sunne, holding the Aſtrolabe by the ring with your right forefinger or middle finger being ſomewhat bowed, in ſuch ſort as the Aſtrolabe may hang plumbe, and then with your left hand lift the Diopter up and downe untill the Sunne with his beame doe iuſtly ſtreeke thorow the holes of each Pinule of the Diopter, ſo as you may ſee the ſhadow of the two holes of the upper Pinule to play upon the two holes of the nether Pinule, then marke upon what degree of Altitude the thinneſt edge or Fiduciall line of the Diopter falleth in the outermoſt ſkirt or border of the backe of the Aſtrolabe, for that is the Sunnes Altitude for that preſent. But if the Sunne be couered with a cloude, ſo as it ſhineth not clear enough to caſt any ſhadow, and yet ſo as it may be ſeene with the eye, then hang the Aſtrolabe by the ring upon your right thumbe, and turning your face towards the Sunne, lift up your hand with the Aſtrolabe ſo high, as by mouing the Diopter with your left hand up and downe, you may with your right eye (the other being ſhut) ſee the Sunne thorow the greater holes of both the Pinules of the Diopter, and marke upon what degree of Altitude the upper end of the Diopter falleth, and that is the Altitude of the Sunne at that time, and in this manner you muſt alſo take in the night ſeaſon, the Altitude of any ſtar.

Proposition IIII.

How to take the Meridian Altitude, that is to ſay, the higheſt or greateſt Altitude of the Sunne or of any ſtar.

GO into ſome open place whereas the Sunne ſhineth ſomewhat before noone tide, and there hanging the Aſtrolabe upon your right fore-finger, or middle finger, take the Altitude of the Sun in ſuch manner as is before taught, at diuers times, with ſome pauſe betwixt euery time to know thereby whether ſuch Altitude increaſeth or decreaſeth, for if it increaſeth, then the Sun is not yet at the Meridian, but if it decreaſeth, then it is paſt the Meridian, and therefore you muſt watch diligently to take him when he is at the higheſt. And you muſt doe the like to take in the night ſeaſon the Meridian Altitude of any knowne ſtarre, ſauing that then you muſt hang your Aſtrolabe upon your thumbe before your right eye and doe as is taught in the laſt Propoſition.

Proposition V.

How to know the Altitude of the Sunne, or of any ſtarre at any houre of the day without ſeeing the Sunne or ſtar

SEt the Finitor at your Latitude, and ſeeke out amongſt the houre-lines or Meridians of the Mater in what point the Parallell or Circle of declination of the Suune crolleth the houre-line which you ſeeke: and the Almicanterath and Azimuth paſſing thorow that point doe ſhew both the Altitude and alſo the coaſt or part of heauen, wherein the Sunne or Starre is at that inſtant, this is a very neceſſary Propoſition, for by knowing the height of the Sunne at euery houre of the day in whatſoeuer ſigne the Sunne is, you may

may make Tables for particular Dyals, as Cylinders, houre-Quadrants, and such like, to serue any Latitude: yea rather this Instrument (as Master Balgrave rightly saith) is a Table of it selfe ready made to serue such purposes. Let the example of his Proposition be thus: Suppose that at eight of the clocke in the morning the 21 of Aprill 1592, the Sunne being then in the tenth degree of Taurus, and his declination 15 degrees Northward, you would know the Altitude of the Sunne at that houre, which by working as the Rule teacheth, you shall finde to bee 30 degrees, and that he is about 16 degrees distant from the East towards the South.

Proposition VI.

How to know the Meridian Altitude of the Sunne, or of any starre every day throughout the yeare, without seeing either Sunne or Starre.



First seeke to know the declination of the Sunne or Starre eyther by the seuenth Proposition next following, or else by some Table, and whether it be North or South, and knowing his declination, bring the Finitor to your Latitude, and staying it there, seeke out in the limbe of the Mater on your right hand the said declination, and there marke what Almicanterah toucheth that point, for that Almicanterah being counted vpon the limbe of the Rete from the Finitor, doth by and by shew the meridian Altitude of the Sunne or starre for that day. As for exrmple, I would know the meridian Altitude of the Sun the first of Iuly 1592, at which time his Parallell or declination is 22 degrees, 1 certaine minutes Northward. Heere hauing laid the Finitor to the Latitude 52, I finde that the 60 Almicanterah toucheth the Parallell, and that is the meridian Altitude of the Sun that day. Againe, suppose that I would know the meridian Altitude of the star Oculus Tauri in

the Latitude 52. Here hauing wrought the Finitor to the said Latitude, I finde that the 35 Almicanterah toucheth his Parallell or declination which is 15 degrees 46′ Northward, so as I find his Meridian Altitude in that Latitude to be 53 degrees. But you haue to note that if the Sunne or Starre haue South declination, then you must count his Parallell from the Equinoctiall outwardes towards the South Pole, so shall you finde the Meridian Altitude of the great dog called Canis maior, whose Southerne declination is 16 degrees, to be 22 degrees & 30′. And by knowing the Meridian Altitude of any star, you may also know how farre he is distant from the Meridian or South line, if you subtract from his Meridian Altitude, his Altitude taken at any other time of the same night, for the remainder will shew his distance from the Meridian, & if the star at the time of taking his Altitude, be in the East part of the firmament, then he is so much short of the Meridian, and if he be in the West, then he is so much past the Meridian. As for example, knowing the Meridian Altitude of Oculus Tauri to be 53 degrees & his other Altitude newly taken to be 30 degrees, I finde his distance from the Meridian to be 23 degrees aswell, by subtraction, as by counting upon the limbe of the Rete the degrees contained betwixt the two foresaid Almicanterahs. And because the said starre was in the East part of the firmament when I tooke his Altitude, I conclude that he wanted 25 degrees of arriuing to the Meridian, which maketh one houre and a halfe, and a little more.

Proposition VII.

How to finde out the declination of the Sunne, or of any star described in the Rete.

THis may be done two manner of waies. First knowing the place of the Sunne, take his place in the Ecliptique line of the Mater, and looke what Parallell of the Mater passeth thorow that degree, and the number of that Parallell will shew the declination (that is to say) how farre the Sun

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is distant from the Equinoctiall, counting from the Equinoctiall upon the outermost Meridian or inner limbe of the Mater & according as the signe wherein the Sun is, be it Northerne or Southerne, so is the declination of the Sunne & must be counted either upward or downward accordingly. The second way is thus: bring the Fiduciall line of the Labell to the degree of the Sunne in the Zodiaque of the Rete, & the number of degrees counted upon the Labell betwixt the limbe of the Rete, and the place of the Sun which the Labell toucheth upon the outward edge of the said Zodiaque will shew his declination. By either of these two waies you shall find the declination of the Suone being in the tenth degree of Taurus to be 15 degrees Northward. And by this last way you may know the declination of any starre contained in the Rete thus. Hauing found in the Rete the starre whose declination you seeke, lay the fiduciall line of the Labell to the longest tip of that star, then count upon the Labell how many degrees are contained betwixt the limbe of the Rete, and that point whereas the Labell toucheth the longest tip of the said starre, and that shall be his declination either Northerne or Southerne, according as the said tip pointeth either outward or inward: for if outward from the Centre, then it is Northerne, if inward towards the Centre, then it is Southerne, as hath beene said before in the description of the Rete. And by doing thus, you shall finde the starre called Canis maior, that is the greater dog, hath in South declination 15 degrees 55′. Againe you shall finde the first star of of the Rammes horne called Cornu Arietis to haue in North declination 18 degrees.

Proposition VIII.

How to finde out the Latitude of any Region.



First you must know the place of the Sun, and also his declination, and having taken his Meridian altitude reckon the same amongst the Almicanteraths, from the Finitor upwards, and turne about the Rete from the Pole Arctique towards the Equinoctiall on your right hand untill it touch-

toucheth the Parliaell of the Sunne, for then looke on your left hand and you shall finde the Finitor to stand at that Latitude which you seeke. As for example, the 12 of Aprill 1591 the Sun being in the first degree 20 minutes of Taurus, and his declination being then 12 degrees Northward, I finde his meridian Altitude to be 50 degrees, which I count vpon the limbe of the Rete proceeding from the Finitor vpwards towards the Zenith, and then I turne the Rete untill I haue brought that Almicanterah to the Parallell of the Sunne, which is 12 degrees, counting the same from the Equinoctiall on the right hand of the Mater towards the North Pole, and there staying the Rete, I finde on the left hand the Finitor lyeth vpon the 52 degree of Latitude, counting from the North Pole downe towards the Equinoctiall. The common way of finding the Latitude is thus, if it be in the day time, then take the meridian Altitude of the Sunne, and if the Sunne bee in any of the six Northerne signes, then subtract the declination of the Sunne out of his meridian Altitude, & the remainder shall be the Altitude of the Equinoctiall aboue your Horizon, which being taken out of 90, the remainder will shew the Altitude of the Pole, but if the Sunne be in any of the six Southerne signes, then you must adde his declination to his meridian Altitude, and the summe thereof shall be the Altitude of the Equinoctiall, which being taken out of 90, the remainder will shew the Latitude or eleuation of the Pole. But to know the Latitude of any place in the night season, you must take the meridian Altitude of some knowne starre which both riseth and setteth: then after that you haue taken his meridian Altitude with your Astrolabe, you must learne to know his declination & whether it be Northerne or Southerne, for if the starre hath North declination, then you must subtract his declination from his Meridian Altitude and the remainder shall be the Altitude of the Equinoctiall, which being taken out of 90, shall be the Altitude or eleuation of the Pole, but if the declination of the starre bee Southernly, then you must adde his declination to his Meridian Altitude and that sum shall be the Altitude of the Equinoctiall, which being taken out of 90, the remainder shall be the eleuation of the Pole. And there be diuers other waies of finding out

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the Latitude of any place, which I haue partly ſet downe in my Treatiſe of the two Globes about the later end thereof, and partly in my Treatiſe of Navigation whereas I ſpeake of the North ſtarre and of his guards.

PROPOSITION XI.

How to know the houre of the day by the Sunne, and alſo in what part of heauen he is at that inſtant.

TAke the Altitude of the Sunne, and knowing the Latitude of the place where you are, bring the Finitor of the Rete to that Latitude, and hauing ſtayed it there, looke in what point the Almicanterahs or Altitude of the Sunne croſſeth the Sunnes Parallell or Circle of declination in the Mater, and the houre-line paſſing thorow that point will ſhew the true houre. And at that inſtant you may alſo know in what Azimuth (that is to ſay) in what part of heauen, or as the Mariners tearme it, in what Rumbe or winde, as Eaſt, Weſt, North or South &c. the Sunne is at that inſtant, for that Azimuth which paſſeth thorow the foreſaid point, is the Azimuth of the Sunne. As for example, the 21 of Aprill 1592. the Sunne being in the tenth degree of Taurus, and his declination being then 5 degrees Northward, I finde by the Aſtrolabe, quadrant or Croſſe ſtaffe, the Altitude of the Sunne in the forenoone to be 30 degrees. Wherefore I haue lait the Finitor to my Latitude which is 52, and ſtayed it there, I marke in what point the Almicanterah cutteth the Sunnes foreſaid Parallell in the Mater, and I find that the houre-line of eight in the forenoone cutteth that point, which ſheweth that it was then eight of the clocke in the morning, and that the Sunne was about 15 degrees diſtant from the Eaſt towards the South.

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Proposition. X.

How to finde the rising and setting of the Sunne every day in every Latitude, and thereby the length of the day, and in what coast or part of the Horizon he riseth or setteth.

BRing the Finitor to your Latitude, and staying it there, looke in the Mater where the Parallell of the Sunne doth cut the Finitor, and the houreline which crosseth that point, will shew the houre of his rising and setting, and the number of houres betwixt his rising and setting is the length of the day, and the number of the Azimuthes betwixt that point of the Finitor and the Centre or first Azimuth, will shew you in what part or coast of the Horizon hee both riseth and setteth. As for example, seeking by this Rule to know at what houre the Sunne riseth the 19 of June 1592 he being then in the sixth degree 39 minutes of Cancer, and his declination then 23 degrees 19. I finde that he riseth 12 minutes before foure, and goeth downe 12 minutes after 8, and thereby I finde the length of the day, counting from Sunne rise to Sunne set, to be 16 houres and 24 minutes, and that he riseth from the East towards North 40 degrees, which according to the Mariners reckoning is North-east and by East, two quarters and somewhat more towards the North.

Proposition. XI.

How to know every day at what houre the Moone riseth and setteth, and how long she continueth above the Horizon, and also when she is full South.

FIrst you must learne by some Almanack or Ephemerides in what signe & degree the Moone is, and whether it be a Northerne signe or a Southerne signe, for if she be in a Northerne signe, then bring her place to the Horizon of your Latitude in ♀ Northeast part of the Astrolabe, but

but if ſhe be in a Southerne ſigne, bring her place to the ſaid Horizon in the South-eaſt part of the Aſtrolabe, and there hauing ſtayed the Rete, bring the Labell to the place of the Sunne for that day, and the Labell will point to the houre of the Moones riſing in the limbe of the Mater: but becauſe the Almanacke or Ephemerides doe not ſet downe the true place of the Moone but onely at noone, you muſt conſider therefore whether it be in the forenoone or in the afternoone that you ſeeke, for if it be in the afternoone you had neede to know how many houres are runne from noone, & then for euery houre, to adde halfe a degree to the place of the Moone which you found at noonetide, but if it bee in the forenoone, then you muſt ſubtract from her place at noone for euery houre halfe a degree, ſo ſhall you go very nigh to find her true place in the Zodiaque for that houre, though you know not her Latitude, which is but 5 degrees at the moſt, and therefore can cauſe no great error in this matter. Now to know when ſhe ſetteth you muſt doe thus: if the Moone be in any Northerne ſigne, then you muſt bring her place to the foreſaid Horizon in the Northweſt part of the Aſtrolabe, and by laying the Labell to the place of the Sunne, it will point to the houre of her ſetting. but if ſhe be in any Southerne ſigne, you muſt bring her place to the Horizon in the Southweſt part of the Aſtrolabe, and the Labell being laid to the place of the Sunne will point to the houre of her ſetting. Now if you would know how long time ſhe is aboue the Horizon, and alſo at what houre ſhe is full South, then count the houres betwixt the riſing and ſetting, and that ſhall be the time of her continuance aboue the Horizon, and the very middeſt of that is the true houre that ſhe is full South. As for example, the fourth day of September 1562. in the Latitude 52. at nine of the clocke at night, the Sunne being in the 21 degrees 47' of Virgo or there abouts, and the Moone being in the 2 degree 30' of Capricorne, I am deſirous to know when the Moone did riſe that day, and by working according to the Rule before ſet downe, I finde that ſhe did riſe about three of the clocke in the afternoone, and that ſhe went downe at ten of the clocke at night and halfe an houre paſt, and that ſhe was full South, or at the Meridian a little before ſeuen of the clocke

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in the afternoone, and by this Rule you may finde out the time of the rising and setting of the Moone, so may you finde the time of the rising and setting of the other fiue Planets, that is Saturne, Iupiter, Mars, Venus and Mercurie, any day throughout the yeare, so as you know their places in the Zodiaque, which the Ephemerides of Stadius doth shew, not onely at noontide, but also at any other houre of the day by helpe of certaine Tables made of purpose, the use of which Tables I haue set downe in the later end of my Treatise of the Two Globes.

Proposition. XII.

How to finde out the right ascention of the Sunne, or of any degree or portion of the Ecliptique.

TAke the Rete and the Labell cleane from the Astrolabe, and seek out in the Ecliptique line of the Mater, the signe and degree whose right ascention you would know, and marke what Meridian cutteth that point: that done, place the Labell upon the pin which standeth in the very Centre of the Iewell, and make the foresaid line thereof to lye right upon and along the Equinoctiall line, either towards your right hand, or towards your left, according as the signe & degree whose ascention you seeke is placed in the Mater. Then marke where the foresaid Meridian cutteth thorow the Labell, & also thorow the Equinoctiall line, and the number of degrees contained in the Labell, betwixt the Centre & that point of the Equinoctiall, is the right ascention of that degree of the Ecliptique which you seeke, which number of degrees, you must count upon the Labell in this manner. For if that signe & degree be contained betwixt the first point of Aries, & the first point of Cancer, then you must begin to count vpon the Labell at the Centre, & so proceed forward towards Cancer, the right ascention of whose first point is 90 degrees, but if the signe & degree which you seeke, be betwixt the beginning of Cancer and the beginning of Libra, which is at the very Centre right against Aries, then you must count vpon the

the Label backward from 90 to 80, by adding to euery 10. ſpace of the Labell 10 degrees, ſo as the firſt number proceeding towards your left hand ſhall be 100, and next to that 110, and ſo forth vntill you come to 180, which is the right aſcention of the firſt point of Libra: and from Libra you muſt count toward Capricorne 190, then 200, and ſo forth vntill you come to 270, which is the right aſcention of the firſt point of Capricorne: and from thence you muſt count 280, 290, then 300, and ſo forth towards the Centre vntill you come to 360, which is the right aſcention of the laſt point of Piſces, ſo as though there be ſet downe in the Labell but 90 degrees both forward and backward, yet 90 being foure times repeated, doe make in all 360, which is the whole Longitude of the Equinoctiall. As for example, you would know perhaps the right aſcention of the tenth degree of Sagittarius, here by ſeeking in the Mater you ſhall finde, that the Meridian paſſing thorow that degree will cut both the Labell being laid towards your left hand, and alſo the Equinoctiall in the 248 degree 21 minutes, which is the right aſcention of the tenth degree of Sagittarius, in counting whereof remember to begin from 180, that is from the Centre, and this aſcention agreeth with the Table of right aſcentions ſet downe in Stadius his Ephemerides the 44 page of his booke. Againe in ſeeking to know the right aſcention of the 10 degree of Taurus, if you begin to count upon the Labell from the Centre, which is the firſt point of Aries, you ſhall finde that the Meridian which paſſeth thorow the 10 degree of Taurus will cut the Labell, & the Equinoctiall line in the 37 degree 35'.

Proposition. XIII.

Another more ready way to finde out the right aſcention of any degree or portion of the Ecliptique by the Rete.

LAy the Finitor euen with the Axeltree, ſignifying heere the right Horizon, ſo as the firſt point of Aries may meet with the Eaſt point of the ſaid Horizon, and lay the Labell right upon and alongſt the Equinoctiall line, either towards Cancer, or towards Capricorne, accor-

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ding as the ſigne and degree which you ſeeke is placed in the Ecliptique of the Mater, and marke therewith what Meridian paſſeth thorow that degree, and follow the ſame vntill it cutteth the Equinoctiall, and alſo the Label lying thereon: and by counting vpon the Label the number of degrees to that point in ſuch order as is before taught, you ſhall haue your deſire. As for example, if you ſeeke to know the right aſcention of the tenth degree of Leo, heere hauing placed the Finitor as before is taught, ſeeke out in the Mater what Meridian paſſing thorow that degree cutteth the ſaid Equinoctiall, and in what point, and lay the Label to the ſaid Equinoctiall, according as the ſigne requireth, be it towards Cancer or Capricorne, and by counting the degree vpon the Label as is before taught, that is from 90, proceeding from the limbe backeward towards the Centre, you ſhall finde the right aſcention of the 10 degree of Leo to be 132 degrees, which differeth from the foreſaid Table but 27′, a thing of ſmall moment, conſidering the narrow ſpaces of the Meridians in the Mater.

Proposition. XIV.

How to finde out the aſcentionall difference of the Sunne, or of any degree or point of the Ecliptique.

BRing the Finitor to your Latitude, and there ſtaying it, looke amongſt the Meridians in the Mater in what point the Parallell of the Sunne cutteth the Finitor, and the number of the Meridians contained betwixt the Areltrée, and that point, ſhall be the aſcentionall difference: As for example, in the Latitude 52, I would know the aſcentionall difference of the Sunne being in the fourth degree of Cancer, at which time his Parallell of declination is 23 degrees Northward: heere by working according to the Rule I finde the aſcentionall difference to be 33 degrees 30′.

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Proposition XV.

How to finde out the oblique ascention of the Sunne, or of any point of the Ecliptique.

Having found the right ascention and also the ascentional difference by the former Propositions, consider whether the declination of the Sunne, or of any other point of the Ecliptique be North or South: for if it be North, then subtract the ascentionall difference out of the right ascention, and the remainder shall be the oblique ascention. But if the declination be South, then adde the ascentionall difference to the right ascention, and the summe thereof shall be the oblique ascention. As in the former example, knowing the declination of the Sunne to be 23 degrees Northward, I subtract the ascentionall difference which was 33 degrees 30 minutes out of the right ascention of the Sunne, which was 94 degrees, and there remaineth 60 degrees 30', which is the oblique ascention of the Sunne being in the fourth degree of Cancer, and his declination being 23 degrees Northward, as is before supposed.

Proposition XVI.

How to finde out the right ascention of any arke or portion of the Ecliptique, and therewith to know what time it spendeth in rising in a right Spheare.

Bring the end of the given Arke found out in the Zodiaque of the Rete, unto the left end of the Equinoctiall marked with D, and there laying it, lay the Fiduciall line of the Label upon the beginning of the said Arke, and the number of degrees in the innermost limbe of the Mater contained betwixt the left end of the Equinoctiall and the Fiduci-

all line of the Labell, ſhall be the right aſcention of that Arke, and the houres ſet downe in the outermoſt limbe whereunto the Labell pointeth, ſhall be the time which the ſaid Arke ſpendeth in his riſing, ſo ſhall you finde the Arke of the whole ſigne Taurus to be 30 degrees, and to ſpend in his riſing two houres.

Proposition XVII.

How to finde out the oblique aſcention of any Arke of the Ecliptique in any Latitude, and what time it ſpendeth in his riſing.

FInd the oblique aſcention both of the beginning & ending of the Arke by the 15 Propoſition, then ſubtract the ſaid aſcention of the beginning of the Arke, out of the aſcention of ỹ ending of the ſaid Arke, alwaies remembring that if the oblique aſcention of the beginning be greater then the other, then to adde to the leſſer 360, and out of that ſumme make your ſubtraction, for the remainder ſhall be the oblique aſcention of the whole Arke, then count the number of that aſcention in the innermoſt limbe of the Water, beginning at the left end of the Equinoctiall marked with D, and ſo proceed upwards towards your right hand, and where the ſaid aſcention endeth, there lay the Labell, and the houre whereunto the Label pointeth, ſheweth the time which the ſaid Arke ſpendeth in his riſing in that Latitude. As for example, I would know the oblique aſcention of the whole Arke of the ſigne of Taurus, and what time that Arke ſpendeth in his riſing: firſt, heere having found the oblique aſcention of the firſt point of Taurus to be about 13 degrees in this Latitude 52, and the oblique aſcention of the laſt point of that ſigne to be about 30; heere by taking 13 out of 30, there remaineth 17 degres. which is the oblique aſcention of the whole Arke of the ſigne Taurus, which 17 degrees I count in the limbe of the Water from the end of the Equinoctial marked with D, upward, and there laying the Labell, I finde that it pointeth to one houre and two degrees which maketh 8', ſo as I

concludo

conclude thereby that the whole Arke of the signe Taurus, spendeth in his oblique ascention one houre and eight minutes.

PROPOSITION XVII.

How to finde out the oblique descention of any point of the Ecliptique in any Latitude.

HAving found out the oblique ascention of the point opposite to the point given, adde thereunto 180 degrees, and the summe thereof shall bee the oblique descention of the point given, alwaies remembring if the summe of addition doe exceed 360, to subtract out of that summe 360, and the remainder shall be the descention of the point given. As for example, you would know the oblique descention of the first point of Taurus whose point opposite is the first point of Scorpio, and his oblique ascention according to Reynholdus his Tables is 222 degrees 36 minutes, whereunto if you adde 180, you shall make the totall summe to be 402 degrees 36 minutes, from which summe if you subtract 360 degrees according to the Rule before given, there will remaine 42 degrees 36 minutes, which is the oblique descention of the first point of Taurus.

PROPOSITION XIX.

How to finde out the oblique descention of any Arke given of the Ecliptique, and therewith to know the time which it spendeth in his setting.

HAving found the oblique descention of the beginning, and also of the ending of the given Arke by the last Propolition, subtract the descention of the beginning out of the descention of the ending, and the remainder shall be the oblique descention of the given Arke, alwaies remembring

membring if the subtraction cannot be made, to adde thereunto 360, that done, divide that by 15, and the quottent will shew the number of houres, which the given Arke spendeth in his setting: and remember that if in making that division, there be any remainder left, to multiply that remainder by foure, and so you shall haue the minutes. By working thus, you shall finde the oblique descention of the whole Arke of Gemini to be 36 degrees 49 minutes, and in the Latitude 52 to spend in his going downe two houres and 24 minutes.

Proposition XX.

How to know the height of any starre at any houre, without seeing the starre, and thereby to finde out in the firmament all the starres that be described in the Rete, and are to be seene with the eye.

LAy the Labell to the houre supposed upon the limbe of the Mater, and then bring the place of the Sunne for that day to the Fiduciall line of the Label, and there hauing stayed the Rete, bring the Fiduciall line of the Labell to the tippe of the star whose altitude you seeke, and the Labell will shew you upon the limbe of the Mater, how many degrees that starre is distant from the South. Againe, by counting upon the Labell, the degrees continued betwixt the point of the Labell, and the tip of the same starre you shall haue his declination, which is North or South, according as the starre is Northerne or Southerne. Then bearing in minde, as well the starres distance from the South, as also his declination, worke thus: Bring the Finitor to your Latitude, and upon the starres Parallell or Circle of declination in the Mater count from the limbe of the Mater, the distance of the starre before found, and marke what Almicanterah crosseth that point, for there is the altitude of the starre at that instant, and the Azimuth which cutteth that

point

point sheweth in what part or coast of heauen the starre is at that present. And remember to seeke the Parallell of the starre on that side of the Mater either on your right or left hand, so as it may fall amongst the Almicanterahs, for otherwise you shall not finde that you seeke. As for example, the 26 of October 1591 at nine of the clocke at night, you would know the height of the first starre of the Rams horne called Cornu Arietis, the Sunne being then in the 12 degrees and 12 minutes of Scorpio. Heere after that you haue laid the Label to the houre supposed, and brought the degree of the Sunne for that day to the Fiduciall line of the Label, and stayed the Rete there, bring the Label to the tippe in the starre in the Rete, and the Label will shew in the limbe of the Mater, how many degrees the starre is distant from the South, which you shall find to be 28 degrees and 30 minutes, and the declination of the said starre being counted vpon the said Label to be 18 degrees, then keeping those two numbers in minde, bring the Finitor to your Latitude, supposing the same to be 52 degrees, and there staying the Rete, seeke for the Parallell of the starre which is 18 degrees on your right hand, and vpon that Parallell count by the Meridians from the limbe inward, the starres distance from the South, which is 28 degrees 30 minutes, and you shall finde that the 49 Almicanterah cutteth that point, so as you may conclude, that the Altitude of the starre called Cornu Arietis, was at that houre 49 degrees, and that the 47 Azimuth doth also passe thorow that point, which sheweth that the starre is 47 degrees from the East towards the South, which according to the Mariners account is Southeast, and somewhat more to the Southward. Now to finde out the said starre in the firmament, if it be starre light, you haue no more to doe but to lay the Diopter of the Astrolabe at that altitude, and to turne your face towards that coast (that is to say) Southeast and somewhat more to the Southward, and the next bright star which answereth in that coast to that altitude is the star which you seeke.

Proposition. XXI.

How to finde out the aſcentionall difference of any ſtarre.

BRing the Finitor to your Latitude, and ſtaying it there, looke in what point the Paralell of the ſtarres declination cutteth the Finitor, and the number of the Meridians contained betwixt that point and the Centre, is the aſcentionall difference, ſo ſhall you finde the aſcentionall difference of the Buls-eye called oculus Tauri, whoſe declination is 15 degrees, 48′, to be 21 degrees.

Proposition XXII.

How to know the oblique aſcention of any ſtarre.

IF the declination of the ſtarre be Northerne, ſubtract the aſcentionall difference out of the right aſcention, and the remainder ſhall be the oblique aſcention of the ſtarre, but if his declination be Southerne, you muſt adde the aſcentionall difference to the right aſcention, and that ſhall bee the oblique aſcention of the ſtarre. As for example, becauſe Oculus Tauri is a Northerne ſtarre, ſubſtract his aſcentionall difference, which is 21 degrees, out of his right aſcention which as the aforeſaid Table ſheweth, is 62 degrees 30′, and there will remaine 41 degrees 30′, which is the oblique aſcention of the ſaid ſtarre. But if it were a South ſtarre, as Spica Virginis whoſe declination is almoſt 9 degrees Southward, and her aſcentionall difference is 11 degrees 30′, then you muſt adde the aſcentionall difference to her right aſcention, which is 195 degrees 51′, ſo ſhall you finde her oblique aſcention to be 207 degrees 21′.

How

Proposition. XXIII.

How to know what ſtarres doe never riſe nor ſet in any Latitude.

If the ſtarre be a Northſtarre, having a greater declination be it never ſo little, then is the altitude of the Equinoctiall anſwerable to your latitude: As for example, ſuppoſe your latitude to be 52, which if you take out of 90, then the remainder is 38 degrees, which is the altitude of the Equinoctiall anſwerable to that Latitude, otherwiſe called the complement, then that ſtarre never ſetteth in that Latitude. Againe, if it be a South ſtarre having greater declination never ſo little, then the complement of your Latitude, then that ſtarre never riſeth above your Horizon. As for example, in the Latitude 52, the ſtarre called Hircus, that is the Goate, being a Northſtarre never ſetteth in that Latitude, becauſe his North declination is 45 degrees, which is greater then the complement of your Latitude by 7 degrees. Alſo the ſtar called Lyra, whoſe declination is 38 degrees, like vnto the complement of your Latitude doth neuer ſet, but only toucheth your Horizon aſwell at his riſing as ſetting, ſo contrariwiſe the ſtarre called Canopus, being a South ſtarr having 51 degrees 31′ of South declination, never riſeth above your Horizon in the foreſaid Latitude 52. And by this Rule youe may iudge in like manner of all the reſt of the fixed ſtarres both North and South.

Proposition XXIV.

How to know at what houre of the day or night any ſtarre riſeth or ſetteth.

First, marke by the outward or inward ſhooting of the longeſt tip of the Starre, whether it be North or South: for if it be North, then count amongſt the Meridians in the Pater ſo many Meridians as your

Latitude amounteth to, beginning at the Arcltrée, and so proceeding towards the Northeast, which is betwixt the North Pole and the Equinoctiall on your left hand, but if the starre be South, then count your Latitude proceeding from the said Arcltrée towards the Southeast, which is betwixt the ringle and the North Pole on the right hand, and bring the tippe of the starre to that Meridian, which now signifieth your Horizon, and there staying the Rete, bring the Label to the place or degree of the Sunne in the Zodiaque of the Rete, in which the Sunne is that day you seeke, and the houre in the limbe whereto the Label pointeth, is the houre at which the starre riseth that day or night. Now to know when the same starre setteth, you haue no more to doe but to worke with the starre in the Northwest part in such order as you obserued before in the Northeast part of the Astrolabe: As for example, I would know at what houre the Buls-eye called Oculus Tauri, doth rise the last day of June, the Sunne being then in the 17 degree and 40 minutes of Cancer. Here because this starre is a North starre, I bring the longest tippe thereof to the 52 Meridian, which is our Latitude counting from the Arcltrée towards the Northeast part of the Astrolabe, which is on my left hand, for that Meridian is alwaies the Horizon seeing the Latitude 52 and there staying the Rete, I bring the Fiduciall line of the Label to the place of the Sunne which at that day is the 17 degrees 40′ of Cancer, as I said before, and I finde that the Label pointeth to one of the Clocke 30′. after midnight, wherefore I conclude that Oculus Tauri riseth that day at that present houre. Now to know at what houre that starre goeth downe the same day, I bring his longest tippe to the said Horizon towards the Northwest, and staying the Rete there, I lay the Label to the 17 degree 40′ of Cancer, as before, so that the Label pointeth to foure houres and 20 minutes in the afternoone, at which time he goeth downe, so as he continueth at that time above the Horizon in the Latitude 52, 14 houres 48 minutes. And to know the abode of any starre above the Horizon, the next Proposition doth also shew.

How

Proposition XXV.

How to know how long any ſtarre continueth above the Horizon in every Latitude.



Bring the Finitor to your Latitude, and looke in what point the Parallell or declination of the ſtarre cutteth the Finitor, and the number of the Meridians in the Water contained betwixt the limbe and that point, doe shew the halfe time of his abode above the Horizon, which being doubled, is the whole time of his abode above the Horizon. And in numbring the ſaid Meridians, whereof 15 doe make an houre, remember to begin to count from the right ſide of the Water, proceeding towards your left hand, and remember alſo that the middle Meridian or Areitræ, ſignifieth alwaies the firſt houre, ſo ſhall you not erre in your account. As for example, having brought the Finitor to the Latitude 52, looke in what point the Parallel of the foreſaid ſtar Oculus Tauri, cutteth the Finitor, and by numbring the Meridians proceeding from the limbe on your right hand towards the left, you ſhall finde the Parallell of Oculus Tauri, being 15 degrees 49, to cut the 111 Meridian, which being doubled, and then the ſumme thereof divided by 15, maketh 14 houres and 48′ as before.

Proposition XXVI.

How to find out the Starres houre, and thereby to know the houre of the night.



Firſt, having taken the ſtarres altitude, ſet the Finitor to your Latitude, and looke at what houre-line in the Water that Starres Almicanterah & the Parallell of his declination doe meet, and having ſought out the ſame houre in the limbe right againſt that point, bring

bring the Labell thereunto, for that is the ſtars houre, and there ſtaying with your fingers end the very point of the Labell, bring the longeſt tippe of the ſtarre to the Fiduciall line of the Labell, and ſtaying there the Rete, turne the Labell to the degree of the Zodiaque of the ſaid Rete, wherein the Sunne is that day, and the Labell will point to the true houre of the night ſet downe in the outward limbe of the Mater. As for example, I ſuppoſe that the ſeventh of October 1591, the Sunne being then in the 23 degree 15′ of Libra, I tooke the Altitude of the ſtarre Hircus, that is the Goate, which I found to be 20 degrees, heere having ſet the Finitor to my Latitude 52, I looke in the Mater at what houre-line that Almicanterah, and the Parallel of the ſame ſtar, which is 45 degrees Northward, doe meete or croſſe one another, and I finde that they meet juſt upon the fourth houre-line of the forenoone, wherefore I ſeeke right againſt that point the ſame houre in the outermoſt limbe of the Mater, for that is the ſtarres houre, and having placed the Labell at that houre, I ſtay it there with my finger, untill I have brought the longeſt tippe of the Starre Hircus unto the Fiduciall line of the Labell, and there ſtaying the Rete, I turne the Labell to the degree of the Sun, which is 23 degrees 15′ of Libra, and I ſee that the Labell pointeth to the ſeventh houre of the night ſet downe in the limbe of the Mater and halfe an houre paſt. M. Blagrave ſaith, that the ſooner you take the Altitude of the ſtarre whereby you ſeeke to know the houre of the night, you ſhall have the houre more truly.

Proposition XXVII.

How to finde out the diſtance betwixt any two ſtarres contained in the Rete.



Firſt conſider whether the declination of both ſtars be either South or North, or that the one be South and the other North, for if both their declinations be South or North, then you muſt not leave to turne the Rete to and fro untill you have brought the longeſt

longeſt tippes of both ſtarres, to one ſelfe Meridian in the Pa-ter, that done, count vpon the ſaid Meridian how many degrées are contained betwixt the tippes of the ſaid ſtarres, for that is the diſtance betwixt them. But if the one ſtarre haue Northy declination and the other South, then turne the Rete to and fro, vntill both ſtarres doe ly vpon two ſuch ſeuerall Meridians, as each of them is equally diſtant on each hand from the Arelträ, then count how many degrées or Meridians are contained betwixt the Arelträ and either of thoſe ſtarres (which you will) and that is their diſtance, ſo ſhall you finde the diſtance betwixt Oculus Tauri, and Canis minor, being both Northy ſtarres, to be 46 degrées 20', and the diſtance betwixt Oculus Tauri, and Canis maior, whereof the firſt is a Northy ſtarre, and the other a South ſtarre, to be iuſt 46 degrées.

PROPOSITION XXVIII.

Another way to know the diſtance of any two ſtarres, their Longitudes and Latitudes being firſt knowne, and alſo by what meanes to finde out the diſtance betwixt any two places vpon the earth.



Firſt ſeeke to know the difference of their Longitudes by ſubtracting the leſſer longitude out of the greater, then count that difference from the outermoſt Meridian of the Pater towards the Centre, and marke well that Meridian at which your account endeth, then number vpon the limbe of the Pater from the Equinoctiall the greater Latitude, either Northward or Southward, according as the Latitude is, and to that point bring the Zenith of the Rete, then vpon the ſelfe ſame Meridian before marked, count from the Equinoctiall the leſſer Latitude, and looke what Azimuth paſſeth through that point, for the degrées which are contained betwixt that point and the Zenith ſhall be the diſtance: and thus doing you ſhall finde the diſtance betwixt Oculus Tauri

and

and Canis major to be 46 degrees and 15', and the distance betwixt London and Venice, to be 12 degrees and 20', which 12 degrees being multiplyed by 60, make 720 miles, whereto if you adde for the 20 minutes 20 miles, it will make in all 740 miles.

Proposition XXIX.

How to finde the degree of Medium cœli *at any houre of the day (that is to say) the degree of the Zodiaque that is in the Meridian at any houre that you seeke, and also the degree called* Imum cœli.

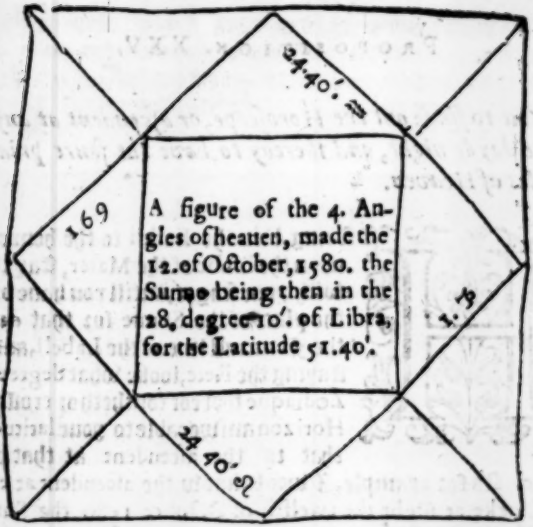
First seeke out the place of the Sunne for that day in the Zodiaque of the Rete, and having laid the Label to the houre supposed upon the limbe of the Pater, bring the place of the Sunne to the Fiduciall line of the Label, and there staying the Rete, looke what degree of the said Zodiaque cutteth the noone line or Meridian at noone tide, which you shall easily finde by laying the Label to the houre of 12 at noone, for the Fiduciall line of the Label crossing the Zodiaque, will shew the degree of mid-heaven at that houre. As for example, the 26 of June 1592 I would know the degree of Medium cœli at eight of the clocke in the morning, the Sunne being that day in the 14 of Cancer. Hereby laying the Label to the said houre in the limbe of the Pater, I bring the place of the Sunne to the Fiduciall line of the Label, and there having staid the Rete, I bring the Label to the twelfe houre at noone, and I finde that the Label cutteth the Zodiaque of the Rete in the 18 of Taurus, which at that houre is the degree of Medium cœli, whose point opposite is the 18 degree of Scorpio, and that is at that houre Imum cœli, which the Label being laid to the twelfe houre of midnight will shew.

How

Proposition. XXV.

How to finde out the Horoscope, or ascendent at any time of the day or night, and thereby to have the foure principall Angles of Heaven.

Having laid the Labell to the houre giuen upon the limbe of the Mater, stay it there with your finger, vntill you haue brought the place of the Sunne for that day vnto the Fiduciall line of the Labell, and there staying the Rete, looke what degree of the Zodiaque thereof toucheth or crosseth the Horizon answerable to your latitude, for that is the ascendent at that present houre. As for example, I would know the ascendent at eight of the Clocke at night the twelfth of October 1580. the Sunne being then in the 28 degree 14' of Libra. Heere hauing laid the Labell upon the said houre, I bring the 28 degree 10 minutes of Libra to the Fiduciall line of the Labell, and there staying the Rete, I finde by helpe of the Labell that my Horizon which is the 51 Meridian, and 40 minutes, counting on both hands from the Axeltree, that the first degree of Cancer doth crosse my Horizon in the Northeast quarter, wherfore I affirme that to be the ascendent or first house whose point oppolite being the first of Capricorne, is the descendent or seuenth house, then by bringing the Fiduciall line of the Labell, to the South end of the Equinoctiall at which the ringle hangeth, I finde by helpe of the Labell that the 24 degree 40' of Aquarius cutteth the Equinoctiall, which is the tenth house, or Culmen cœli, whose point oppolite being the 24 degree 40' of Leo, is the fourth house, otherwise called Imum cœli, and thus you haue all the foure principall houses of heaven for that houre, as you may see in this figure heere following.



But the difficulty of finding out the true ascendent consisteth in knowing whether it is to be sought in the Northeast quarter or in the Southeast quarter of the Jewell. The Northeast quarter is that which lyeth betwixt Imum cœli and the North Pole, or East end of the Arcitræ, because in this case the Arcitræ signifieth the line of the East and West, and the Equinoctiall signifieth the line of the South and North, at the South end whereof is fastned the ringle or handle. But in the former example you may plainly see that the North part of the Zodiaque of the Rete doth cut the Horizon, as well in the Northeast quarter as in the Southeast quarter with two seuerall degrees & signes, for in the Northeast quarter of the Zodiaque cutteth the Horizon with the first of Cancer which is the ascendent, & in the Southeast quarter it cutteth the Horizon with the eight of Taurus, which is not the ascendent: for you haue to vnderstand that euery degree of the Zodiaque doth both rise and set either towards ỹ North or towards the South, the first point of Aries & of Libra only excepted, both which do rise right East, & go down right West, euen as the

Equi-

Equinoctiall doth, whereof M. Blagrave doth gather a Rule how to finde out by his Iewell, when the aſcendent is to be ſought either in the Northeaſt quarter of the Mater, or in the Southeaſt quarter, which is thus: The aſcention of any of the ſix Northern ſignes is to be ſought for, in the Northeaſt part of the Iewell, & the aſcention of any of the ſix Southern ſignes is to be ſought for in the Southeaſt part of the Iewell. For although that the North part of the Zodiaque of the Rete, containing the 6 Northerne ſignes cutteth the Horizon anſwerable to your latitude, aſwell in the Northeaſt as in the South eaſt part of the Iewell yet you muſt ſeek the aſcendent in the Northeaſt part, & not in the Southeaſt part of the Iewell, becauſe that euery degree of any of the ſix Northerne ſignes, riſeth Northernly: ſo contrarywiſe if the South part of the Zodiaque containing the ſix Southerne ſignes doe cut the Horizon, aſwell in the Northeaſt part as in the Southeaſt part of the Iewell, yet you muſt ſeeke the aſcendent in the Southeaſt part, and not in the Northeaſt part of the Iewell. As for example, the ſecond day of Auguſt 1592, the Sunne being in the 20 of Leo, I would know the aſcendent at foure of the clocke in the afternoone: heere hauing laid the Label to that houre, and brought the place of the Sunne to the Fiducial line thereof, I finde that 13 degrees 30′ of Aquarius doth cut the Horizon ſeruing to your Latitude 52 in the Northeaſt part of the Iewell, and that the 9 of Sagittarius cutteth the ſaid Horizon in the Southeaſt part of the Iewell, which muſt be the aſcendent, becauſe euery degree of any of the Southerne ſignes riſeth Southernly, and not Northernly.

Proposition. XXXI.

How to finde the Circles of poſition, and to know how much the Pole is elevated above every ſuch Circle in any Latitude, without the knowledge whereof you cannot finde out the twelve houſes by this Aſtrolabe.

FIrſt bring the Zenith of the Rete to your Latitude, ſo ſhall the Azimuthes become circles of poſition, then upon the Parallell or declination of the point given, according as the declination thereof is North or South: count from the limb on your right hand, the number of the houres

given

given amongst the Meridians in the Mater, & the Azimuth which the Meridian of that houre cutteth shall be the circle of position, which had, you shall finde the elevation of the Pole above the circle of position thus: Count your latitude amongst the Almicanterahs from the Zenith upon the Circle of position found, & to that point whereas your Latitude endeth, bring the Fiduciall line of the Label, & rection upon the Label how many degrees are contained betwixt the limbe of the Rete & that point, for the number of those degrees is the elevation of the Pole above the Circle of position. As for example, used by M. Blagrave himselfe, the 12 of October 1580. the Sunne being then in the 29 degree 10' of Libra, and his South declination 11 degrees 10'. I would know at 8 of the clocke at night in what circle of position the Sunne at that time was. Here I bring the Zenith to the latitude of Reading, which is 51 degrees 40', then for 8 of the clocke I count 8 houres amongst the Meridians in the Mater, from the South part of the Jewell upon the Parallell of the Sun being then 11 degrees 30, and by attributing to every houre 15 Meridians, I find that the Meridian whereas the 8 houre endeth doth crosse the 28°. ½ Azimuth counting the Azimuths from the Zenith line, & that is the Circle of position wherein the Sun was then under the earth in the Northeast quarter. Now to know how much the Pole is elevated above ỳ Circle of position, I doe count from the Zenith the foresaid Latitude 51 degrees 40' upon the said Circle of position, and to the point where that latitude endeth I bring the Label, and counting thereon from the limbe of the Rete, the degrees contained betwixt the said limbe, and the foresaid point, I find the number of them to be 43 degrees 30', wherefore I conclude that the Pole is elevated above the said Circle of position 43 degrees 30'.

Proposition XXXII.

How to finde out all the 12 houses of heauen, and thereby to erect a figure at any houre of the day or night.

You shall understand the order of this better, by this one example given by M. Blagrave himselfe, then by manifold rules, which be also so plainly expressed & observed in this example, as you neede none other instruction

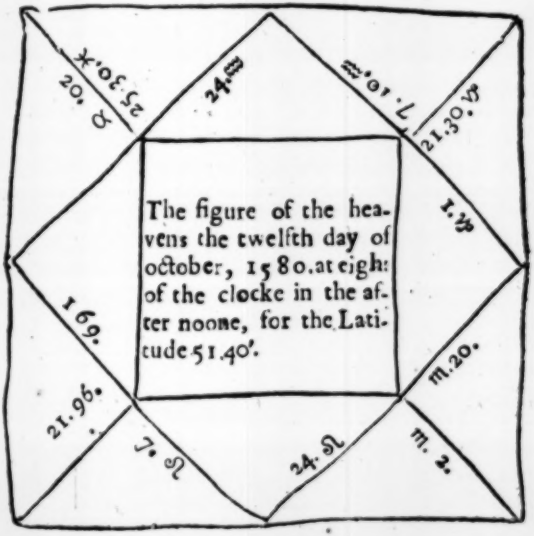
to erect the like figure in any latitude, and at any houre of the day or night. Suppose then that you would erect a figure for one that was borne the twelfth of October 1580, at eight of the clocke at night in the latitude 51, 40′, the Sunne being then in the 28 degree 10′ of Libra, and his declination being at that time 11 degrees 10′ Southward. Here, first set downe in your figure already drawne, the foure Angles before found by the 30 Proposition answerable to the said day and houre, then to finde out the rest of the houses, doe thus: bring the Zenith of the Rete to the Latitude presupposed, which is 51 degrées 40′, and staying it there, mark what number of Azimuthes or Circles of Position doth cut every 30 degree of the Equinoctiall counting the degrées of the Equinoctiall by helps of the Meridians from the limbe towards the Centre, but you must count the number of the Azimuths or circles of position from the zenith line towards the limbe, of which circles of position there be no more but five at the most (that is to say) three betwixt the limbe & the Centre on the one side, and as many on the other side of the Centre, the elevation or rather depression of every one, whereof you must séeke to know by the last proposition. But M. Blagrave saith that you néed to know the elevation or rather depression, but onely of two Circles of position, that is of that which sheweth the eleventh & third house, and of that which sheweth the twelfth & second house, and so saith Stadius also, in the beginning of his Ephemerides, treating of the 12 houses, for having them, you have all the rest. The order of working, according to M. Blagrave his rule is thus having brought the Zenith to the foresaid Latitude, looke what Circle of Position cutteth the Equinoctiall in the first 30 degres next to the limbe, and you shall find that the 47 Azimuthes or circle of position (counting from the Zenith line) cutteth that point of the Equinoctiall, and therewith serveth to the eleventh house, and also to the third house, and the elevation of this Circle is 32 degrees, then from thence fell upon the Equinoctiall 30 degrees more, which doe make in all 60 degrees, and through that point you shall find the 19 Azimuth or circle of position to passe, whose elevation is 47 degrees, and this circle serveth to the 12 house and to the second house. Now keeping well in mind those two last

elevations, that is 47 & 32, worke thus: Lay your Label to the 8 houre of the morning, which is 30 degrées distant from the right Horizon or Arcticæ, and bring to the Fiduciall line thereof the Culmen cœli or 10 house, first set downe in your figure which is the 24 of Aquarius, and staying it there, looke what degrée of the Ecliptique cutteth the 32 Horizon, which serueth to the 11 house, counting from the right Horizon towards your left hand. And by following that Horizon up toward the North Pole you shall find that the 25 degrée 30′ of Pisces cutteth the same Horizon very nigh unto the Pole, but by my instrument I find it to be the 27 degrée of Pisces, which perhaps is not truely made, & therfore set downe in the 11 house of your figure 29 degrées 30′ of Pisces, then bring thy foresaid Culmen cœli together with the Label to the tenth houre of the morning, which is 30 degrées further towards the South, and staying it there, looke what degrée of the Ecliptique cutteth the 47 Horizon serving to the 12 house, and you shall finde that the 20 degrée of Taurus cutteth that Horizon, wherefore set downe the 20 of Taurus in the 12 house of your figure, then bring the Culmen cœli together with the Label to the 12 houre at noone, and you shall see the ascendent which is the first of Cancer, to cut the oblique Horizon which is 51 degrees 40′, and from thence bring the Labell and Culmen cœli to two of the clocke in the afternoone, and staying it there, you shall see the 21 degree of Cancer to cut the 47 Horizon, which sheweth the 2 house, and also twelfth house as before, wherefore set down the 21 of Cancer in the second house of your figure, that done, remoue the Labell together with Culmen cœli to foure of the clocke in the afternoone, and there staying it, you shall see the seventh of Leo to cut the 32 Horizon, which sheweth both the third house and the eleventh house, as before, wherefore set the seventh of Leo in the third house of your figure, so have you eight of the houses, that is to say, the first, the second, the third, the fourth, the seventh, the tenth, called Culmen cœli, the eleventh & the twelfth, so as there want onely foure, that is, the fifth, the sixth, the eighth, and the ninth house. The fifth is opposite to the eleventh, the sixth to the twelfth, the eighth to the second, & the ninth to ỹ third, whose opposite signes each one having like number of degrees,

are

are to be placed in the foure houses of your figure that be wanting. As in the fifth house the 25 degree, 30' of Virgo, in the sixth house, the 20 degree of Scorpio in the eight house, the 12 degree 30' of Capricorne, and in the ninth house the 7 degree 10' of Aquarius, so have you all the twelve houses. And by this meanes M. Blagrave saith that you may make the places of the 12 houses to serve for ever in any Latitude, so as you doe distinguish from the rest with some colour those two Horizons whereof the one doth shew the eleventh and the third house, and the other Horizon sheweth the twelfth and second house, yea and by this meanes you may (as he saith) make as true Tables to find out the twelve houses in every Latitude, as those that be calculated of purpose.

The figure of the foresaid twelve houses.





A

NEVV AND NECESSARY TREATISE OF NAVIGATION,

containing all the *chiefe Principles of that* ART.

Lately collected out of the beſt Moderne Writers thereof, by M. *Blundevil*, and by him reduced into ſuch a plaine and orderly forme of teaching, as every man *of a meane capacity may eaſily underſtand the ſame.*



They that goe downe to the Sea in Ships and occupy their buſineſſe in great waters: Theſe men ſee the workes of the Lord, and his wonders in the deepe. *Pſalme* 107.

A

NEW AND NECESSARY

TREATISE OF NAVIGATION,

containing all the chiefe Precepts

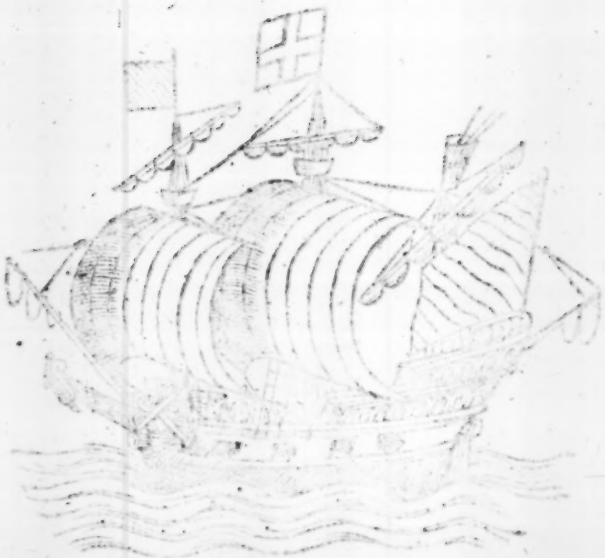
of that ART.

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dern Writers direct, by M. Blundevil,

and by him reduced into such a plaine

and orderly forme of teaching, &c.



OF NAVIGATION, VVHAT IT IS, AND WITH WHAT ORDER THE Principles thereof are here taught by Master BLVNDEVIL, *according to the Rules of best moderne writers of that* ART.

NAVIGATION is an Art which teacheth by true and infallible Rules how to governe and direct a Ship from one Port to another, safely, rightly, and in shortest time: I say here safely, so far as it lyeth in mans power to performe. And in saying rightly, I meane not by a right line, but by the shortest and most commodious way that may be found: and by saying in shortest time, I meane thereby according as the Ships good of sayle, and according as both wind and tyde shall serve.

The meanes to attaine to this Art, as to all other Arts, are two parts, whereof every Art consisteth, that is, Method and Practice, which is as much to say heere, as instruction and experience: For of the chiefe points of this Art, some are to be learned by instruction, and some only by experience: for what instruction I pray you will serve to make a good coaster, that is to say, to know any Cape or Cliffe when he seeth it, unlesse hee hath first seene it and hath before taken good markes thereof. And to know the currents in all places, the depth and qualities of

waters, sands, flats, or shoules, and such like the perfect knowledge whereof consisteth chiefly in experience. Of which experience I mind not here to treat, because I know that a Dutchman called Wagonet or Aurigarius, hath lately written of these things notably well, and especially for these our Seas, and the Northeast Seas, whose booke I doubt not, but that some of our learned Seamen will set forth in our mother tongue, with some augmentation of their owne experience for the East and West Indies, for the profit of their Countrey, and to their own praise and commendation. In the meane time I will proceed with instruction, the chiefe points whereof are these three following: 1, to know the uses of such instruments, as every skilfull Sea-man ought to have with him that mindeth to saile any long voyage, which are these three following: First, a perfect Kalender or Ephemerides, the Mariners ring or Astrolabe, the Crosse staffe called of the Spaniards Balla stella, the two Globes both Celestiall and Terrestriall: of all which things I have in a manner already written severall Treatises. Item, An universall Horologe, or Diall, to know thereby the houre of the day in every Latitude, and a Nocturnlabe to know thereby the houre of the night. And it were necessary for him that saileth long voiages, to carry with him a Topographicall instrument to describe thereby those strange Coasts and Countries whereby he saileth: the use of which Instrument is plainly taught by William Borne in his booke called the Treasure of Travellers, and by Master Digges, in his booke called the Pantometria, wherefore I shall not need to speake any further thereof. Also the Mariners Compasse whereof I doe not only make a plaine description, and shew the uses thereof, but also how to find out the variation of the same, according to the precepts of the best modern writers thereof. And lastly the Mariners Card, whereof whilest I speake, I doe not only shew the making thereof, and how to draw the Parallells in better sort then they are used to be drawen in the common Cardes, but I set downe therewith the chiefest uses of the Card, amongst which I taught how to know by helpe of the Card, and certaine Tables made of purpose, what way your ship hath made in sailing by any Rumbe or wind, yea in saying

right

right East and West, which heretofore (as Cognet saith) hath bin thought a thing vnpossible to be knowen, but only by coniecture And being out of the way how to know in what place you are, & to marke the same in your Card, that you may the more readily direct your ship againe to the place whereunto you would goe. But all these instruments serue to little purpose, vnlesse you know also the North Star, with his guards, & diuers other Starres situated aswell towards the North as towards the South Pole, together with their Longitudes, Latitudes, declinations, and greatnesse, to know thereby the Latitude of any place, and the houre of the night: also the course of the Sunne and his declination, by helpe whereof you may know the Latitude of any place, the times and seasons of the yeere, the houre of the day, and the length of the day and night in every Latitude. And finally, you must know the course of the Moone, whereon dependeth the knowledge of the tydes in all places: of all which things I minde heere to treat in such order as the Chapters hereafter following doe shew.

A generall Kalender or Almanacke for ever, containing these 9 Chapters next following.

HOw to find out the Golden number every yeere. Chap. 1.
How to find out the Epact in every yeere. Chap. 2.
How to know the *Epact*, by the Marriners rule vpon your thumbe. Chap. 3.
How to know the age of the Moone in every moneth throughout the yeere. Chap. 4.
How to know the change, full, and foure quarters of the Moone euery moneth throughout the yeere. Chap. 5.
How to know in what signe and degree the Moone is every day throughout the yeere. Chap. 6.
How to find out the moueable feasts every yeere only by knowing the day of conjunction in the moneth of February. Chap. 7.
How to find out the Cycle of the Sun, called in Latine *Syclus Solaris*, and thereby the Dominicall letter, in every yeere. Chap. 8.
How to find out the number of indiction. Chap. 9.

A briefe description, together with the vse of the Diurnall Table or Almanacke of *Iohannes Stadius*. Chap. 10.
How to finde out the place of any Planet by the Ephemerides. Chap. 11.
Of the Marriners Ring, or Astrolabe, and of his Crosse-staffe. Chap. 12.
A briefe description of M. *Hood* his Crosse-staffe, and of all the parts thereof. Chap. 13.
How to set the parts of M. *Hoods* staffe together, to serue such Astrono-

Aſtronomicall uſes as doe chiefly belong to the Marriner. Chap. 14.

The ſhape or figure of the foreſaid ſtaffe, having all the parts ſet together to ſerve for Aſtronomicall uſes. Chap. 15.

How to take the altitude of the Sunne at any houre that hee is to be ſeene with the eye by M. *Hoods* ſtaffe. Chap. 16.

How to take the altitude of any ſtarre with M. *Hoods* ſtaffe, Chap. 17.

How to take the diſtance betwixt two Starres with M. *Hoods* ſtaffe. Chap. 18.

Of the Marriners Aſtrolabe. Chap. 19.

A brieſe deſcription of the Marriners Aſtrolabe, and the uſe thereof. Chap. 20.

A brieſe deſcription of the Marriners Croſſe-ſtaffe. Chap. 21.

The uſes of the Marriners Croſſe-ſtaffe. Chap. 22.

Of the wind, what it is, and of the divers kindes and names thereof. Chap. 23.

A briefe deſcription of the Marriners Compaſſe, and uſe thereof. Chap. 24.

Of the Loadſtone, and of the variation of the Compaſſe in Northeaſting, and Northweſting. Chap 25.

How to find out the Variation of the Compaſſe in every latitude. Chap. 26.

Of the Marriners Card and the making thereof. Chap. 27.

The ſhape and figure of the firſt lineaments of the Marriners Card drawne after the old manner, and how to ſet downe the places of the Land or Sea therein. Chap. 28.

A Table to draw thereby the Parallels in the Marriners Card, together with the uſe thereof in truer ſort then they haue beene drawn heretofore. Chap. 29.

The draught of the Meridians and Parallels of the Marriners Card or Nauticall Planiſpheare according to the former Table. Chap. 30.

The foure chiefeſt uſes of the Marriners Card. Chap. 31.

How to know the way of your ſhip, and how many leagues are to be accounted for one degree of Latitude in every Rumbe whereby you ſaile. Chap. 32.

How to account the leagues in ſayling directly Eaſt or Weſt without

without changing latitude or altitude of the Pole. Chap. 33.

A Table to helpe you to know what way your ſhip hath made in ſayling right East or West without changing your Latitude, together with a briefe deſcription and vſe thereof. Chap. 34.

An example of counting the way of your ſhippe in ſayling right West. Chap. 35.

Another example of counting the way of your ſhip in ſayling right East. Chap. 36.

To know how much you goe out of your way in ſayling by one wrong Rumbe, or by more. Chap. 37.

Of the North ſtarre, otherwiſe called the Loadſtarre, and of his guardes, and how to know the ſame. Chap. 38.

The uſes of the North ſtarre, and of his guards. Chap. 39.

To know by help of a little Table made according to the Mariners Rule touching the eight principal Rumbs, ſhewing how much and when the Loadſtar is either above or beneath the Pole, that you may know therbythe true altitude of the pole in taking the height of the Loadſtarre with your Aſtrolabe, or Croſſe-ſtafie. Chap. 40

How to make an Inſtrument, which will ſhew at any houre of the night, how much the Load ſtarre is either above or beneath the Pole in every other Rumbe, as well as in the eight principall Rumbes, and alſo the true houre of the night. Chap. 41.

How to know by the foreſaid two fold Inſtrument as well the mounting and deſcending of the North ſtarre, as the true houre of the night both at one inſtant, and alſo the elevation of the Pole. Chap. 42.

What ſtarres are to be obſerved by thoſe that ſaile beyond the Equinoctiall vnder the South Pole. Chap. 43.

Of the Sunne, and of his motion, and of the chiefeſt apparances belonging to him. Chapter 44.

A Table ſhewing the declination of the Sun every day throughout the yeare, and the vſe thereof. Chap. 45.

Of the foure ſeaſons of the yeere, that is, Spring time, Summer, fall of the leafe, called otherwiſe Autumne, and Winter. Chap. 46

How to know when the Sunne riſeth and ſetteth in every latitude, and thereby the length of the day and night, and alſo in what Rumbe or wind, he riſeth and ſetteth, and how much he declineth every

every day from the Equinoctial, either Northward or Southward: Alſo how to know the elevation of the Pole, otherwiſe called the Latitude of any place, by knowing the Meridian Altitude of the Sunne, and his declination. Chap. 47.

Of the ſhadow of the Sun, and how thereby to know the houre of the day in any latitude by help of an univerſall Diall. Chap. 48.

Of the Moone and of all her divers motions. Chap. 49.

How to know what ſigne the point *Auge* of the Moone is in any yeere. Chap. 50.

When the Moone is ſaid to be in conjunction with the Sunne or to be at the full, and what her greateſt latitude is, as well from the Ecliptique line, as from the Equinoctiall. Chap. 51.

How to know in what part of the Zodiaque the head of the Dragon is every yeere. Chap. 52.

How to know the tides in any place by the Moone. Chap. 53.

How to know by the helpe of an inſtrument the tides at any place. Chap. 54.

How a generall Rutter ſhewing the tides in all places ſhould be made. Chap. 55.

A generall Kalender or Almanacke for ever.

WHat this word Kalends signifieth, and from whence it is derived, is before set downe in the first booke of my Treatise of the Spheare, the 45 Chapter. But because there are generall Rules to know the conjunction of the Moone with the Sunne, her full, and all her foure quarters, and also the moveable feasts and Dominicall Letter, and such like things, easily to be learned without the helpe of any particular Kalender, I thought good first to set downe this generall Kalender, containing 9 Propositions, as followeth.

Chap. I.

How to finde out the Golden number every yeere.

THe Golden number is the number of 19, proceeding from 1 to 19, and so to begin againe at 1. And it is so called because it was sent in golden letters from Alexandria in Egypt to Rome for in 19 yeares the Moone doth make all her sundry motions & changes, and returneth againe to the place where she first began. And to finde the foresaid number the way is thus. Adde 1 to the yeere of the Lord whereof you enquire, and divide the same by 19, and the remainder shall be the golden number for that yeere. As for example, being desirous this present yeare 1590, to know the Golden number, I adde 1 to the said yeare, and so make it 1591. which being divided by 19, there remaineth 14, which is the Golden number of this present yeere.

But when there is no remainder, then 19 is the Golden number, and remember that the Golden number beginneth alwaies at the first of January, and the Epact the first of March.

How

Chap. II.

How to finde out the Epact in every yeere.

The Epact is a number not exceeding 30, because the Moone betwixt change and change, never passeth 30 daies, and thereby the common Lunar yeeres consisting of twelve Moones is lesser then the Solar yeare by 11 daies, for to every Moone are attributed no more but 29 dates and a halfe, which make in all 354 daies, so as the common Solar yeare consisting of 365 daies exceedeth the Lunar yeare 11 daies, from whence the Epact taketh his originall, which Epact is found thus: Multiply the Golden number of the yeare by 11, the product whereof if it be under 30, then it is the Epact. But if the product be above 30, then divide the product by 30, & the remainder shal be the Epact. As for example, to know the Epact in the yeare 1590, the golden number being 14 as before: heare having multiplyed the same by 11, and divided the product thereof by 30, I find the remainder to be 4, which is the Epact of the said yeare. Also by knowing one former Epact, you shal have it ever after by adding thereunto 11, & if the number do exceed 30, then you must divide the same by 30, and the remainder shall be the Epact as by adding 11 to 4. I know the Epact shall be the next yeare which is 1591, the number of 15 and by adding 11 to 15, the Epact in the yeere of our Lord, 1592, shall be 26, and so forth.

Chap. III.

How to know the Epact by the Mariners Rule upon your thumbe.

First you must suppose the inside of your left thumbe to be divided into three spaces, and the nethermost space to containe 10, the middle space 20, and the highest space toward your thumbs end, to contain 30 and knowing first the Golden number, begin to tell the same at the nether space, saying there 1, at the middle space 2,

at

at the third ſpace 3, then begin againe at the loweſt ſpace, and there ſay 4, and ſo continue your account ſtill, after that manner vntill you haue the full ſomme of the Golden number, and marke vpon what ſpace the full ſumme falleth, for the Golden number being added to the number of that ſpace, doth ſhew the Epact, ſo as the totall ſumme doth not exceed 30. for then you muſt ſubtract 30, and the remainder ſhall be the Epact: As for example, in the yeare 1591, the Golden number is 15 which being counted vpon your thumbe, in ſuch order as is before taught, it will fall vpon the higheſt ſpace which is 30, to which if you adde the Golden number which is 15, it will make in all 45, from which ſumme, if you ſubtract 30, there will remaine 15, which ſhall be the Epact for that yeare, ſo as the Epact and Golden number in that yeare are alike numbers. For every three yeares they are alwaies alike, as when the Golden number, is either 3, 6, 9, 12, 15, or 18, the Epact hath alſo like number.

Chap. IV.

How to know the age of the Moone in every month throughout the yeere.

ADde to the Epact the number of moneths from the beginning of March, together with the moneth wherein you ſeeke, and alſo the number of the daies paſt of that moneth, wherein you ſeeke, and the ſumme of ſuch addition will ſhew you the age of the Moone, as for example, I would know the age of the Moone: the firſt day of December, in the yeare 1590. Heare knowing the Epact of that yeare to be 4, I adde thereto the number of the moneths from the beginning of March, which are 10 moneths, and alſo the number of daies of December, which are ſix, and the ſumme thereof is the age of the Moone, if the ſumme be leſſe then 30. But if the ſumme of ſuch addition doe exceed 30, then you muſt ſubtract 30, and the remainder ſhall be the age of the Moone, ſo as the moneth wherein you ſeeke haue 31 daies, for if it hath

leſſe

leſſe then 31 daies, then you muſt ſubtract but 29, and the remainder ſhall be the age of the Moone: as for example, ſuppoſe you ſeeke the age of the Moone the 22 of November in the yeere 1589, in which yeere the Epact was 23, heere by adding to the Epact, firſt 9 moneths, and then twentie two daies, it maketh in all, 54, out of which by ſubtracting 29, becauſe November hath but 30 daies, the remainder is 25, which was the age of the Moone in that moneth, day, and yeere.

Chap. V.

How to know the Change, the full, and foure quarters of the Moone every moneth throughout the yeere.

Martin Cortes, in his booke called the Art of Navigation teacheth a Rule to finde the day of the change in every moneth, by knowing the age of the Moone that day you ſeeke, and then by reckoning from that day backeward the number of the daies that went next before, or elſe by taking the age of the Moone out of the daies of the moneth that went next before: as for example, the laſt of October 1592, I finde by the fourth Propoſition the age of the Moone to bee 5, which being taken out of 31, (for ſo many daies October hath) there remaineth 26, which day by this meanes ſhould be the day of the change. but the very day indeed was the 25 of the ſaid moneth, for the former Rule to know the age of the Moone is not ſo true it ſelfe, but that ſometime it will fall a day either over or under. But Gemma Friſius, teacheth to find out the day of the change in every moneth thus: Adde to the Epact the number of the moneths from the beginning of March whereof that moneth wherein you ſeeke the change, muſt bee counted as one, and then ſubtract the product or ſumme of that addition from 30, and the remainder will ſhew the day of the change, which Rule I find to be true ſo long as the ſumme of the addition doth not exceed 30, but when the ſumme of the addition is more then 30, which will commonly chance when the Epact is a great number, as 26, or 29, he teacheth no Rule for that, wherefore I

thinke it beſt to take that ſumme out of 59, and the remainder ſhall be the day of change, or at the moſt but one day ouer or vnder, and hauing the day of the change, you ſhall haue the day of the full by adding 15 daies more to the day of change: and hauing the change and the full, you ſhall eaſily haue all her foure quarters by adding or ſubtracting 7 daies.

Chap. VI.

How to know in what ſigne and degree the Moone is euery day throughout the yeere.

Some doe ſet downe Rules to know in what ſigne and degree the Moone is euery day, but ſuch as are not true. And to ſay the truth, the Moone hath ſo many diuers motions as it cannot be done but by ſpeciall Tables calculated of purpoſe. And by what Rule ſoeuer you worke, you muſt firſt know the place of the Sunne, which the Ephemerides moſt truly sheweth, and in looking for that, you ſhall alſo find hard by it the place of the Moone, that is to ſay, in what ſigne and degree ſhee is euery day, and ſo orderly the place of any other Planet, and therefore I leaue to ſpeake any further thereof.

Chap. VII.

How to find out the moueable feaſts euery yeere only by the knowing the day of conjunction in the moneth of February.

The way to finde out the conjunction in euery moneth is before taught in the fifth Chapter. And hauing the day of conjunction in February, you may aſſure your ſelfe that the next Tueſday following is alwaies Shrouetueſday, for though the conjunction it ſelfe doe fall vpon a Tueſday, yet the next Tueſday after that ſhall be Shrouetueſday, and the next Sunday after that, is called Quadrageſima, which is the firſt Sunday in Lent, and ſix weekes next after that is

is Easter day, whereunto if you adde five weekes more, that is to say 35 daies, you shall have Rogation-Sunday, and foure daies next after that is Ascention-day, and ten dayes next after Ascention day is Pentecost or Whitsunday, & seven daies next after that, is Trinity Sunday, and foure daies next after that is a Festivall day called Corpus-Christi. And you have to note that the Sunday called Adventus Domini, which we call the first Sunday in Advent, is alwaies the fourth Sunday before Christmasse day, and the Sunday called Septuagesima is the third Sunday before Quadragesima, otherwise called the first Sunday in Lent, and betwixt Septuagesima and Quadragesima, there are other two Sundaies, whereof that which is next before Quadragesima, is called Quinquagesima, and the next Sunday before that is called Sexagesima.

Chap. VIII.

How to find out the Circle of the Sunne called in Latine by a Greekish name Cyclus Solaris, *and thereby the Dominicall Letter in every yeere.*

This Circle was invented more to find thereby the Dominicall Letter, than to shew any great changes of the Suns motions therein. And because there be seven daies in the weeke commonly signified by seven Letters, A, B, C, D, E, F, G. This Circle therefore is made to containe twenty eight yeers, for foure times seven doe make twenty eight, by helpe whereof is known the true order of the Letters, whereof A signifieth alwaies the first day of every yeere, and for every leap-yeere are appointed two Dominicall Letters, whereof the one continueth from the beginning of that yeare untill Saint Matthias, and the other from thence to that yeares end, as you shall more plainly perceive by that which followeth. And first, I will shew you how to find out the iust number of the Circle of the Sun every yeare which is done thus.

Adde to the yeare of the Lord given or ſuppoſed 9, and diuide that product by 28, and the remainder ſhall be the number of the foreſaid Circle. As for example, I would know the number of the ſaid Circle in the yeare 1590, whereunto by adding 9, I make the ſumme to be 1599, which being diuided by 28, there remaineth 3. Now to finde out the Dominicall Letter, by the number of the ſaid Circle, you muſt reſort to the figure following, conſiſting of three Circles, making two ſpaces, in the upper ſpace whereof are ſet downe the foreſaid ſeuen letters, and in the nether ſpace the numbers of the Sunnes Circle, in ſuch ſort as euery number hath his proper Dominicall letter ſtanding right ouer his head, and for euery leape yeare, there are ſet downe two Dominicall Letters. All which letters are to be counted backward, and not forward as they are placed in the Almanacks: As for example, hauing found the number of the Sunnes Circle for the yeere 1590, to be three in the lower ſpace, you ſhall find out the letter D. ſtanding ouer his head, which is the Dominicall letter for that yeare. And note that when 28 is the number of the Sunnes Circle, A is alwaies the Dominical Letter, from which number you muſt begin to count againe at one, and ſo proceed backward to 28.



Chap. IX.

How to find out the number of Indiction.

This number consisteth of 15 yeares, and is commonly set downe in all the Charters of the Bishops of Rome, and in the instruments and writings of their Pronotaries, and therefore is called Indictio Romana, wherein they seeme to follow the ancient Romans, which used the like Indiction of yeares, but to other purposes, whereof I make mention in my Sphеare. The way to find out this number every yeare is thus, adde to the yeare of the Lord given 3, and divide the product thereof by 15, and the remainder shall be the number of the said Indiction. But you have to understand that this Indiction is to be counted from September, and not from March, as is the Epact.

But the surest, and therewith the most generall Kalender to serve in all places is the Ephemerides, or daily Almanacke and especially that of Origanus, which will serve for many yeeres yet to come: And before those yeeres be all expired, I doubt not but that the like will be set forth by some one or other of our learned Mathematicians, amongst whom for many yeeres past, the Germains have bin most famous. Whose the Ephemerides of Stadius, which is now expired, and many other good ones, let ly set forth, because he is more portable, and of lesse price, then that great Ephemerides of Leovitius. The chiefest use whereof, and most meet for Mariners, though I have already set downe in the latter end of my Treatise of the Globes, to the intent you might by the helpe thereof, find out in the Globe the true place of the Moone, and of every one of the other 5 Planets, that hath both Longitude and Latitude, yet I thinke it good once againe here in this place, most properly requiring the same, briefly to shew the use of the said Ephemerides, and specially of the diurnall Table, which beginning at the yeere of our Lord 1583, endeth with the yeere 1606.

Chap. X.

A briefe description together with the use of the diurnall Table or Almanacke of Iohannes Stadius.

This description is also proper to any of the other and may be readily applied thereto

THis Table beginneth at the 202 Page of his booke called the Ephemerides, or daily Almanacke. And every page of the said Table, that is on the left hand is divided into 9 collomes. In the first collome whereof, on the left hand, are set downe the daies of the moneth. First, the Gregorian daies, according to the Romane account, and next to that the daies of the moneth, according to our English account, and then in the front of every other collom are set downe the characters, first of the Sunne, and then of the other six Planets, that is to say, of the Moone, Saturne, Iupiter, Mars, Venus, Mercury: & last of all, the head of the Dragon, figured thus ☊ And right under the seven Planets, and also under the head of the Dragon, are set downe the signes and degrees to be in, every of these is every day of the moneth throughout the yeere at noone tide. And in the foote of the said Table is set down the Latitude of every one of the five Planets, proceeding by the daies of the moneth, divided into three parts. And in the margent of every left page, are set downe the chiefest feasts and Saints daies, that fall in every month throughout the yeere. And moreover, in the Table on the right hand, right against the left Table are set downe, first the daies of the month, and then what conjunction, or any other aspect the Moone hath with any of the other six Planets, that is, with the Sunne, with Saturne, with Iupiter, with Mars, with Venus, and with Mercury, which Planets are set down in the front of the said Table, and under them the Characters of such aspects as the Moone hath that day with any of the other Planets. The Characters of which aspects are these here following.

☌ ☍ △ □ ✶

Whereof the first signifieth a Conjunction, the second an opposition, the third a trine aspect, the fourth a quadrant aspect, and the fift a sextile aspect.

Two

Two Planets are said to be in a conjunction when they are both in one selfe signe.

And to be in an oppositon when they are in two several signes distant one from an other 180 degrees, which is the whole signes or one halfe of the Zodiaque.

And to be in a trine aspect, when they are distant one from another by foure signes, or one third of the Zodiaque.

And to be in a quadrat aspect, when they are distant one from another by three signes, which is 90 degr. or ¼ of the Zodiaque.

And to be in a fertile aspect, when they are distant but two signes one from another.

CHAP. XI.

How to find out the place of any planet by the Ephemerides.

HOw to finde out the place of any Planet, or of the head of the Dragon by this diurnal Table, you must first seeke out the day of the moneth in the first collome of the left Table, & right against that on your right hand in the said left Table, you shall finde in the common Angle right under the Planet or Dragons head, which soever of them you seeke, the signe and degree wherein the said Planet or Dragons head is the said day at noone tide.

And to find out the aspects which the Moone hath with any of the Planets the same day, you must resort to the other Table on the right hand, observing like order as before.

The Example.

As for example, the 21 of April, 1592, which is the first of May according to the Romane account, I find by the Table on the left hand the Sunne to be in the 10 degree 15 minutes of Taurus, the Moone to be in the third degree 47 minutes of Capricorne, Saturne to be in the 8 degree 10 minutes of Cancer, Iupiter to be in the 18 degree, 28 minutes of Sagittarius, Mars to be in the 12 degrees, 51 minutes of Gemini, Venus to be in the second degree 0 minutes of Aries, and Mercury to be in the 6 degree 20 minutes of Taurus, and the head of the Dragon to be in the 29 degree 45

minutes of Gemini. And right against this in the Table on the right hand, you shall find the Moone to be in a trine aspect with the Sunne, to be in an opposition with Saturne, to be in a trine aspect with Mercury.

Thus much touching generall Kalenders or Almanackes. Now as for particular Kalenders I take that which Robert Norman hath set downe in his new attractive to be the fittest for our country men, which containeth many necessary things, as the contents thereof, together with the Table next following the same doth shew, which Kalender I thinke it superfluous to be set down againe here, and the rather for that I wish every Mariner not to be without that booke, and especially containing besides the Kalender many other good precepts touching Navigation, to which booke is also joyned a very learned and Mathematicall discourse, touching the variation of the Mariners compasse made by Master William Borough controuler of her Maiesties Navy, who in my opinion is one of the skilfullest men in the Art of Navigation that is in this Realme.

Chap. XII.

Of the Mariners Ring or Astrolabe, and of his Crosse-staffe.

NOw according to the order set downe in the beginning of this Treatise, I must needs speake somewhat of the common Mariners Ring or Astrolabe and of his Crosse-staffe, which serve not to so many purposes, as that of Stoflerus or of M. Blagrave before described, but onely to take the Altitude of the Sun, or of any Starre, or Planet, neither are so many conclusions to bee wrought by their common Crosse-staffe, as by that of Gemma Frisius, or by that which Master Hood hath lately invented. Sith our Mariners for the most part do use their cõmon Crosse-staffe to none other end, but either to take the altitude of the Sunne, or of any fixed Starre or Planet, or else to take the distance betwixt two Starres, the making of which Staffe is plainely set downe by Martin Cortes, in his Art of Navigation, and also the making of their Astrolabe.

But Cogniet and Wagoner do set downe a new kind of Crosse-staffe

staffe having 3 Transames or Crosses every one longer & shorter then another by the one halfe, affirming that so many conclusions may be wrought thereby, as by that of Gemma Frisius, but in mine opinion they are not to be compared in al respects to that of Gemma Frisius, which though by reason that the yard thereof is of so great a length, as it is not manuable in a ship, yet upon the land it is most serviceable, nor yet to that of M. Hoods invention, which is most manuable, and therewith very light of carriage, by whose staffe I think verily that as many things may be wrought as by any other kinde of Crosse-staffe whatsoever, and with lesse trouble, yea, and in matters of Astronomie more truely, by reason that the yard and transame be of one selfe length, and therby the degrees be larger throughout the whole quadrant then they be in ỹ common Crosse-staves, for in them, the degrees from 50 upwards to 90 are very small have narrower spaces then M. Hoods staffe hath. Again whereas in using the Mariners Crosse staffe in such latitude as the Sun beames be of great force, they are faine to have glasses made of purpose to save their sight, and in some places all to little. But in using M. Hoods staffe they shall not need to behold the Sun it selfe at al, but only to marke upon what degree of the yard the shadow of the Vane striketh. Moreover, when the Sunne or Star is 50 or 60 degrees high, they are faine to use their Astrolabe & not their staffe, which Astrolabe in mine opinion, as I have said before, is the best instrument of al others to take the altitude of the Sun in the day, or of any starre in the night, and because I have heere commended unto you M. Hoods staffe, I will first set downe a plaine description thereof together with those few Astronomicall uses which do chiefly belong to the Mariner, without committing any offence I hope to the Author thereof, and then I will describe unto you the Mariners Ring, and his common staffe together with the uses of the same.

But as I was about to describe unto you M. Hoods staffe, a friend of mine comming in the mean time, desired me that I would first set down the making and use of the Crosse staffe with three Transames, which Wagoner and Michaell Cognet do so much commend, and as I heare, is used of many sea men in these daies, whose request I could not well deny, and therefore loe heere followeth both the making and use thereof.

Of

Of the Crosse-staffe having three Transomes or Cursours commonly used in these daies, the use and making whereof doth after follow according to the descriptions of Wagoner, and Michael Cognet.

FIrst prepare a right staffe of firme wood, that is square every way, bearing in thicknesse 3 quarters of an inch, & in length three or foure foot, for which you must also prepare three Transames or Cursours, every one shorter then an other by the one halfe, for the longest would containe in length twelve inches, the second, six inches; and the shortest, or least, three inches. And every one of these Transames or Cursours must be cut with a square hole in the very midst, so as they may be made to run iust upon the staffe to and fro, these things being prepared, you must divide three sides of the staffe into certaine degrees to serve three severall Cursours as followeth.

First, you must upon a smooth square Table, somwhat longer every way then the staffe, & for want of one such Table you may ioyne two Tables, that may stand even together, draw by help of a true long squire a right Angle marked with the Letters, A, B, C, and let A, be the right Angle, and the Centre as you see in figure following and let both the sides of the said Triangle be of like length to your staffe, then putting the one foot of your Compasse in the Centre A, & extend the other foot B or C, draw a quarter of a Circle from C, to B, and having divided that quarter into two equall parts, make a pricke in the middest marked with the Letter D, and laying your Ruler to that prick, and to the Centre A, draw a right line, which shall be A, D, then devide the halfe Quadrant D, B, into nintie equall parts making 90 equall degrees proceeding from B, to D, so as the first degree may be at B, and the 90 at D: that done, take with your Compasse the iust halfe of the longest Transame, & keeping your Compasse at that wideneſſe, set the one foot in the Centre A, and the other foote in the line A, C, so farre as that wideneſſe will extend, and there make a pricke marked with the letter *E*, then from that point draw a right line that may be a Parallel to the line A, B, which

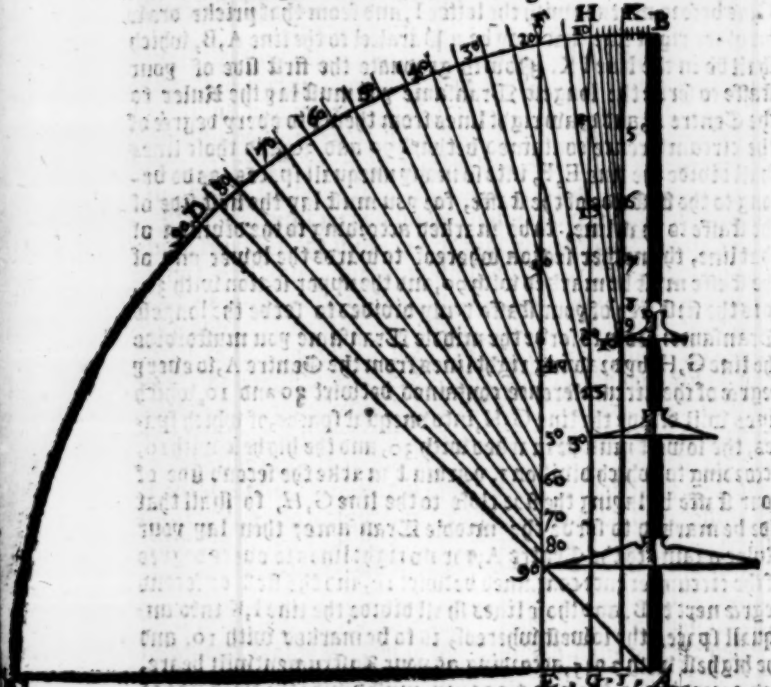
line

line shall be E,F, then take with your Compasse the halfe of the middle Transame, and keeping your Compasse at that wideneſſe ſet the one foote in A, and the other foote in the line A,C, ſo farre as that wideneſſe doth extend, and there make a prick marked with the letter G, and from that pricke draw a right line that may be a Parallell to A,B, which line shall be G,H. Thirdly, take the one halfe of the leaſt Transame with your Compaſſe, & transferre that wideneſſe to the line A,C, ſetting the one foot of your Compaſſe in A, & make a prick with the other foote in the line A,C, as before marked with the letter I, and from that pricke draw an other right line that may be a Parallel to the line A,B, which ſhall be in the line I K. Now to graduate the firſt ſide of your ſtaffe to ſerue the longeſt Transame you muſt lay the Ruler to the Centre A, and draw right lines from thence to every degree of the circumference contained betwixt 90 and 30, and thoſe lines ſhall divide the line E,F, into ſo many unequall ſpaces, as do belong to the firſt ſide of the ſtaffe, for you muſt lay the firſt ſide of the ſtaffe to that line, to be marked according to the diviſion of that line, the nether ſection whereof, towards the lower end of the ſtaffe muſt be marked with 90, and the upper ſection with 30, ſo is the firſt ſide of your ſtaffe truly divided to ſerue the longeſt Transame. Now to ſerue the middle Transame you muſt divide the line G,H, by drawing right lines from the Centre A, to every degree of the circumference contained betwixt 30 and 10, which lines will divide the line G,H, into unequall ſpaces, of which ſpaces, the loweſt muſt be marked with 30, and the higheſt with 10, according to which diviſions, you muſt marke the ſecond ſide of your ſtaffe by laying the ſame cloſe to the line G,H, ſo ſhall that ſide be marked to ſerue the middle Transame; then lay your Ruler againe to the Centre A, & draw right lines to every degree of the circumference contained betwixt 10, and the firſt or ſecond degree next to B, and thoſe lines ſhall divide the line I,K into unequall ſpaces, the loweſt whereof, is to be marked with 10, and the higheſt with 2 or 1, according as your Inſtrument will beare, and according to thoſe ſections you muſt divide the third ſide of your ſtaffe by laying the ſame cloſe to the ſaid line I K, and remember to make your lines of diviſion ſo finely as is poſſible, ſo

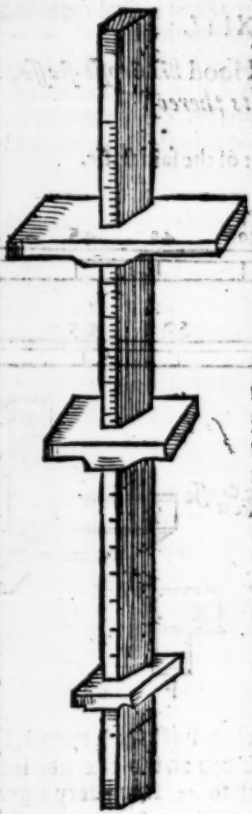
that

shall your Staffe be the more truely graduated. And note that in graduating your Staffe, you shall not need to draw right lines from the Centre to every degree of the circumference, contained betwixt the 90 degree and the 60 degrees; for when the Sunne or any Starre is higher then 60 degrees, you must use your Astrolabe and not your Staffe, which will not serve you to looke so right up to take so great an altitude, either of Sunne or Starre.

A figure of the foresaid Triangle.



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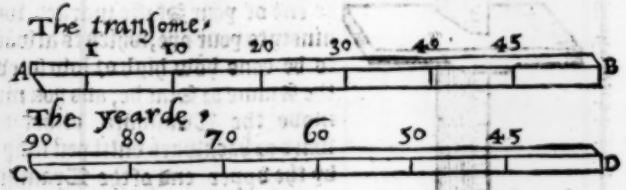


The Shape of the Staffe with his three Transames, together with the use thereof.

Whensoever you would take the Altitude of the Sunne or of any Starre, you have first to consider whether the Sunne or Starre be 30 degrees or more high: for then you must place the longest Transame upon your Staffe. And set the lower end of your Staffe marked with ninety to your eye, which is alwaies to be done how high or low so ever the Sunne or Star be, and you must move the Transame, either forward or backward until you may see by the upper end of the Transame the body or middest of the Sunne or Starre, and with the neather end of the Transame, the Horizon; and then looke in what degree the Transame cutteth the Staffe, for that is the Altitude of the Sunne or Starre at that present, but if the Sun be not 30 degrees high, then you must put on the middle Transame, and if he be lesse then ten degrees high, you must put on the shortest Transame, and then doe as before. Thus much touching the Crosse-staffe with three Transames: now I will describe unto you Master *Hoods* staffe, and shew you the use thereof.

Chap. XIII.

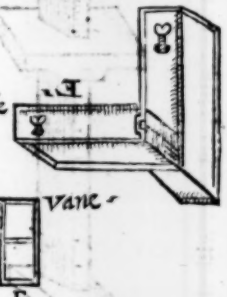
A brieſe deſcription of Maſter Hood *his Croſſe-ſtaffe, and of all the parts thereof.*

The figure or ſhape of every part of the ſaid ſtaffe.



THis inſtrument as you ſee conſiſteth of foure parts.

Firſt, of two ſquare Rulers each one bearing in thickneſſe three quarters of an inch, or there abouts, every way ſquare, and in length I would with each Ruler not to containe above one yard, for then in ſome uſes they would ware ſoppe heavie.



Of which two Rulers the one marked with the letters A, B: is called the Tranſame, which is divided on the one ſide into 45 degrées, beginning at one and ſo forth to 45. And every degrée is divided againe into ſix leſſer parts, making 60 minutes, for ſix times ten maketh 60, which ſerveth for Aſtronomicall uſes.

And on the oppoſite ſide to that, the ſaid Tranſame is divided into 1000 equall parts beginning at 25, and ſo increaſeth by 25, untill you come to 1000. Every which 25 parts is divided into five leſſer parts, and every one of thoſe againe into five parts, which maketh in all 25, for five times five is 25, and this ſerveth for Geometricall uſes.

The

The other ſquare Ruler called the yard and marked with the letters C, D, is divided into degrees like to thoſe of the Tranſame proceeding from 45 to 90, which together with thoſe degrees that be in the firſt ſide of the Tranſame, doe make up the number of a iuſt Quadrant, to ſerve Aſtronomicall uſes. And the ſide oppoſite to that is divided into a 1000 equall parts proceeding from 25 to 25, like in all reſpects vnto the oppoſite ſide of the Tranſame to ſerve Geometricall uſes.

The third part belonging to this inſtrument, is a double ſocket of braſſe marked with this letter E, ioyned together with right Angles and ſtanding croſſe one to another. And each ſocket hath a ſkrew to kæpe the ſame faſt to his ſtaffe at any degræ that you liſt to ſet the ſame: and alſo a long notch, to the intent it may be laid cloſe to any degree of the Ruler whereto it belongeth.

The fourth part belonging to this inſtrument, is a Vane of braſſe marked with the letter F, the upper edge whereof is pearced with a little round hole for the beame of the Sunne to paſſe through the ſame; and this Vane is made with a ſocket, and with a ſkrew to hold it faſt to that Ruler whereon it is ſet. And for certaine Geometricall uſes, it were neceſſary (as ſome thinke) that there were two ſuch Vanes.

Thus having deſcribed all the parts of the foreſaid inſtrument, I will now ſhew you how to ſet thoſe parts together: which to ſerve Aſtronomicall uſes, is thus done.

Chap. XIV.

How to ſet the parts of M. Hoods *ſtaffe together to ſerve ſuch Aſtronomicall uſes as do chiefly belong to the Marriner.*

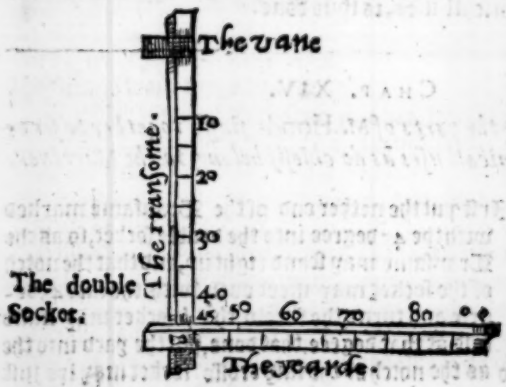


Firſt put the nether end of the Tranſame marked with the 45 degree into the double ſocket, ſo as the Tranſame may ſtand right up, and that the notch of the ſocket may meet even with the ſaid 45 degræ: and turne the ſkrew, that the ſocket may ſtand faſt at that degree. that done, put the yard into the croſſe-ſocket, ſo as the notch of the ſaid croſſe-ſocket may lye iuſt upon

upon the 45 degree of the yard, and there make it fast by turning the skrew then put on the Vane, which to serve Astronomicall uses must be set at the highest end of the Transame, in such sort as the upper edge of the Vane pearced with the hole may stand even with the first point or streak of the said Transame, and when the Transame standeth on the left hand of the yard, then the Vane must be placed on the right side of the Transame: but if the Transame doe stand on the right hand of the yard, then the Vane must be placed on the left side of the Transame: And the yard and Transame would be so set together as the degrees of the Transame proceeding downward from one to 45. may looke towards you, that is to say, may stand right before your face: And the degrees of the yard proceeding from 45 to 90, would lie upward, so as the end of the yard marked with 90 may point to your breast or set to your eye as occasion shall require, for such Astronomicall uses as here do follow.

Chap. XV.

The shape or figure of the foresaid staffe, having all his parts set together to serve for astronomicall uses.



How

Chap. XVI.

How to take the altitude of the Sunne at any houre that he is to be seene with the eye, by M. Hoods Staffe.



THe Staffe being set in such order as is before taught, go into some open place, where as you may see the Sunne, and turning the end of the yard marked with ninety towards your brest, hold the yard so levell as you can, that it may be a full Parallell to the Horizon, and turne both your face, and all the Vane of the Transsume toward the Sunne. Then you have to consider together the Sunne at that present be either just 45 degrees high, or more, or lesse then 45 degrees, which you shall easily know thus: For if it be just 45 degrees high, then the shadow of the upper edge of the Vane will streak just upon the 90 degree of the yard lying at your brest. But if he be more then 45 degrees high, then the shadow of the Vane will streke short of the 90 degree: And if it be lesse it will cast no shadow at all upon the yard, but streke plaine beyond it over your shoulder. Now knowing by this meanes whether the altitude of the Sunne be more or lesse then 45 degrees, you shall take his true altitude thus.



If his altitude be lesse then 45 degrees, then shall you draw the Transsume to slide downe through the former and [illegible] of the Vane standing upon the Transsume doe fall [illegible] upon the nineteenth degree of the yard. Then looke at what degree the notch of the Socket wherein the Transsume standeth, doth cut the said Transsume for that is the true Altitude of the Sunne at that instant.

But if the altitude of the Sunne be more then 45 degrees, then draw the double socket upon the yard higher toward your brest, until you see the shadow of the Vane to fall full upon the ninetieth degree of the yard: that done, looke upon the degree of the yard next north of the double Socket cutteth, and that is the true Altitude of the Sunne at that instant.

Chap. XVII.

How to take the altitude of any ſtar with M. Hoods ſtaffe.



Here is no difference betwixt the order of the taking of the altitude of the Sunne and of any ſtarre, but only that in taking the altitude of any ſtarre, you muſt ſet the end of the yard marked with the 90 degree to your eye, ſtaying the ſame upon the upper bone of your cheeke, and that in ſuch ſort as you may ſee the ſtarre by a right line paſſing from the end of the yard, lying at your eye, to the upper edge of the Vane at one inſtant, being alwaies ſure that the yard ly levell, making a juſt Parallell to the Horizon, which Horizon is eaſier to be ſeene upon the Sea then upon the Land, for on the Sea there be neither hils nor trees to hinder the ſight thereof.

Chap. XVIII.

How to take the diſtance betwixt two ſtarres with Maſter Hoods ſtaffe.



The inſtrument being ſet in ſuch order as was firſt taught: Set the end of the yard marked with 90 at your eye: and let the other end of the yard directly point to one of thoſe ſtarres whoſe diſtance you ſeeke, and turne the edge of the Vane to the other ſtarre, be it on the right hand or on the left, according as you thinke good your ſelfe: then you muſt conſider whether the diſtance of the two ſtarres be juſt 45 degrees or more or elſe leſſe, for if it be juſt 45 degrees, then the outward edge of the Vane and the end of the yard marked with 90 will be anſwerable in your ſight to that diſtance without any more adoe. But if the diſtance be leſſe then 45 degrees, which you ſhall eaſily perceive by your eye (for then the ſtarre that is on your right or left hand, will appeare within the Vane and fall ſhort thereof) then you muſt thruſt downe the Tranſome in his ſocket, untill you may ſee the two ſtarres by a

right

right line passing from the end of the yard marked with 90 and lying at your eye, right forth to the outward edge of the Vane, that done, looke what degree the double socket cutteth the Transame, and that shall be the true distance of the two starres. But if the distance of the two starres be more then 45 degrées, which you may know also by your eye, because the starre which is on your left or right hand, will appeare cleane without the Vane: then draw the double socket together with the Transame towards your eye, untill you may see the two starres by a right line as before, and the degrées which the noteh of the double socket cutteth on the yard, shall be the true distance of the two starres.

Thus much touching the Astronomicall uses of M. Hoods staffe meet for the Mariner. Now as for setting of the said staffe to serve Geometricall uses and to find out the manifold conclusions to be done thereby, I wholly referre you to M. Hoods owne booke thinking it good not to speake somewhat of the Mariners Astrolabe or King, and of his usuall Crosse-staffe.

Chap. XIX.

Of the Mariners Astrolabe.



Michael Cogniet setteth downe the making of a new kinde of Astrolabe, which he calleth an universall Astrolabe, onely because the declination of the Sun every day is added in manner of a Table to the one end of the Diopter of the said Astrolabe, which is of no great importance, sith the Sunnes declination doth alter in the space of 30 yéeres and lesse, which being expired, the declination is to be new calculated: In the meane time that Table which Norman hath set downe in his attractive, and also that which is more lately calculated set downe by my selfe in the first part of my Spheare, and likewise in this Treatise: whereas I treate of the motion of the Sunne and of his declination, may serve those 20 yéeres and more without any great error: Wherefore leaving to speake any further of Cogniet his universall Astrolabe, I will describe here the common Astrolabe and Crosse-staffe used by most Mariners, the shape or figure of both which héere followeth.

CHAP. XIX.

Of the Planisphaerie Astrolabe.

Chap. XX.

A briefe description of the Mariners Astrolabe, and the uses thereof.

The limbe of the Mariners Astrolabe is traced as you see with three Circles, making two spaces to containe therein the degrees and numbers of altitude: and these Circles are divided by two crosse lines, called Diameters, and cutting one another in the very Centre of the Astrolabe, into 4 equall parts, of which quarters the uppermost on the left hand towards the Ringle, is onely marked with degrees and numbers, as you may see in the figure: In which figure the perpendicular Diameter signifieth the Zenith, or the line of South and North, at the upper end whereby is fastned the Ringle or handle. And the other overthwart Diameter signifieth the Horizon, the one end whereof on the left hand, signifieth the East point, and the other end on the right hand, the west point. And to this Astrolabe (as to all other) doth belong a Ruler or Diopter, which as you see hath at each ende a square tablet pearced with two holes, the one greater and the other lesser, the greater to looke thorow with your eye, to take the altitude of any Star, or of the Sunne, being so darkened by some cloud as though it casteth no shadow, yet it may be seene with the eye: And the lesser hole is for the Sunne beame to passe through when hee shineth cleare, and some Astrolabes are divided in like manner on both sides of the Zenith, and have two Diopters, whereof the one is pearced with a great hole, and the other with a smaller hole to serve to such purposes as is abovesaid.

The use of this Astrolabe is onely to take the Altitude of the Sunne at any time of the day, or of any fixed Starre or Planet in the night, in such sort as he is before taught in my description of Master Blagrave his Astrolabe, in the third and fourth Proposition thereof.

Chap. XXI.

A brieſe deſcription of the Mariners Croſſe-ſtaffe.

THis ſtaffe conſiſteth of two foure ſquare Rulers of wood, whereof the one is called the yard, and the other the Tranſame or Croſſe: and the yard containing in length moſt commonly three quarters of a yard, is the longer peece, and is divided into 90 unequall degrees: for from 1 to 90 the degrees doe grow leſſer and leſſer, and the Tranſame containing for the moſt part but one third part of the yard, is cut with a ſquare hole in the middeſt, ſo as it may runne up and downe upon the yard, and ſome Tranſames have two running Vanes to be ſet at what wideneſſe you liſt, to take thereby the diſtance of any two ſtarres.

Chap. XXII.

The uſes of the Mariners Croſſe-ſtaffe.

THe uſe of the Mariners ſtaffe chiefly conſiſteth in two points, that is, to know thereby the altitude of the Sun in the day time, or of any ſtarre in the night ſeaſon, and the other is to know thereby the diſtance betwixt any two ſtars.

The firſt is thus done, having put the ſtaffe or yard thorow the ſquare hole of the Tranſame, ſet the end of the yard, which is marked with 90 to your eye, laying that end upon the upper point of your cheeke bone, keeping your legs cloſe together, and having directed the other end of the yard towards the Sun or ſtar, whoſe altitude you ſeeke, move the Tranſame to and fro, or up & downe untill you may ſee (with the one eye (winking with the other) the one end of the Tranſame to meet juſt with the Centre or middeſt of the Sun or ſtar, and the other end to touch the Horizon both at one inſtant, & that degree of the yard, which the ſquare edge of the Tranſame cutteth, will ſhew how high the Sun or ſtar is at that preſent: and in taking the altitude of the Sun or of any ſtar, remember alwaies to hold the yard ſo levell, as it may be a iuſt parallell to the Horizon, for ſo ſhall you take the altitude the more truly.

truly. Now as touching the second point, which is to know the true distance betwixt any two starrs, you must doe thus.

Set the end of the yard marked with 90 to your eye as before, and move the Transame to and fro, untill you may see the one end of the Transame to answer the one starre, and the other end thereof to answer the other star, for that degree of the yard which the Transame cutteth, will shew the distance betwixt the two starres, and if the two starres be so nigh together, as they will not conveniently answer the two ends of the Transame, then you may use the two moveable Vanes, which, (as I said before) you may set at what wideneſſe you list, but yet so as they may both stand equally distant from the Centre of the Transame, or from both ends thereof.

Thus having shewed the use of the Mariners Ring & Crosse-staffe, I will now proceed to the other instruments, whereof the two Globes are part, which Globes I have already described and shewed the chiefe uses thereof in a Treatise by it selfe, and as for the universall Horologe, to know thereby the equall houre of the day in every Latitude, & also the Nocturnall, he to know the houre of the night, I shal speake of the one when I come to speake of the Sunne, and of the other when as I treat of the North starre and of his guards, for there I will set downe the figure and shape of each instrument, and shew how to use the same: But the two chiefest instruments belonging to a Mariner, are his Compasse and his Card, whereof I come now to speake.

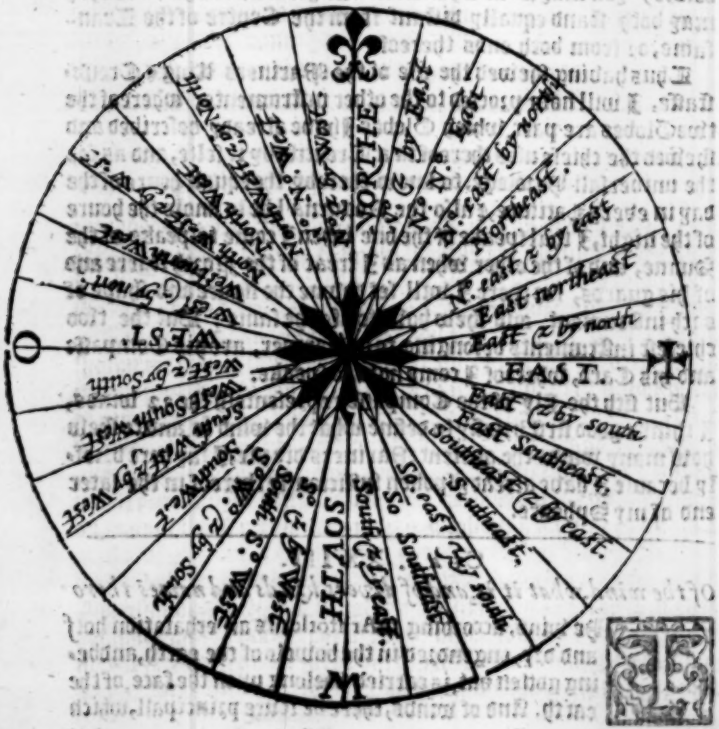
But sith the Fly of the Compasse representeth the 32 winds, I thinke good first briefly to define what the wind is, and to shew how many winds the ancient Mariners did use, I say here briefly because I have already spoken sufficiently thereof in the later end of my Spheare.

Chap. XXIII.

Of the wind, what it is, and of divers kinds and names thereof.

The wind, according to Aristotle, is an exhalation hot & dry, engendred in the bowels of the earth, and being gotten out, is carried violently upon the face of the earth. And of winds, there be foure principall, which

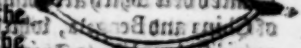
doe take their names from the foure quarters of the earth, from whence they blow, that is, North, South, East, and West: and though the Greekes and the Latines divide every quarter into three parts, and thereby make in all but twelve windes, whose names both Greeke and Latine are set downe in the latter end of my Sphearе, yet our latter Sea-men to be the more assured of their Routes and Courses, doe divide every quarter of the Horizon into eight windes, so as in all they make 32 winds, giving them such names as are set downe in this figure here following, representing the Fly of the Mariners Compasse.



Chap. XXIIII.

A briefe description of the Mariners Compasse, and the use thereof.

THe Mariners Compasse may be very well divided into 2 essentiall parts, that is, the Fly, and the Ayre, touched with the Loadstone, called in Latine Magnes. And first you have to understand, that the Fly is a round white Card, traced with 32 lines all passing through the Centre of the Circle, which lines doe signifie the 32 windes in such sort as the figure before set downe doth shew, of which lines, that which is marked with the Flower-deluce signifieth the North, whose point opposite is the South, and that which is marked with a Crosse signifieth the East, whose point opposite is the West, and the uttermost Circle of the said Fly signifieth the Horizon, which Circle is also divided into 360 degrees, like to those of the Equinoctiall, so as every space betwixt point and point, containeth 11 degrees and 15 minutes, which is the fourth part of a degree. Moreover, this Circle is divided into 24 houres by allowing to every point three quarters of an houre, which is 45 minutes, for an houre containeth 60m. and halfe an houre containeth 30m. and the quarter 15m. Moreover the common Mariners doe divide every point of the Compasse into foure quarters, to make the more exact account of their Rootes or Rumbes. But now as touching the second essentiall part of the Mariners Compasse, which is the Ayre, you shall understand that they are of yron or Steele, and made in this forme, and being touched at the one end with the Loadstone, they are fastned to the backeside of the Fly, either right under the line marked with the Flower-deluce, or else somewhat distant from the North, either towards the East or else towards the West, for such cause as shall be declared in the next Chapter, for these Ayres being thus touched, doe make that part of the Fly that is marked with the Flower-deluce, to stand alwaies towards the North, and to



that

that end the Fly having in the Centre a latten socket, is put into a turned box, in the middest whereof is a sharpe pointed Latten pinne, upon which the Fly turneth about, and that turned box is covered with glasse, partly to keepe the Fly cleane, but chiefly that the wind should not meve it to and fro. And this turned box is hanged by two round narrow plates of Latten, in another square box of thinne wainscot board, so as it may alwaies hang level, howsoever the ship swaieth or inclineth on either side, and though of the Mariners Compasse there be divers uses as you shall receive hereafter, yet the chiefest end and use thereof is to shew the North part of the world, whereby the Ship-master knowing what course he hath to hold, and how the part or place to which he goeth, beareth from the place from which he departeth, may by looking alwaies to his Compasse, know how to direct his ship accordingly.

CHAP. XXV.

Of the Loadstone, and of the variation of the Compasse in Northeasting and Northwesting.

THe Loadstone or Adamant, called in Latine Magnes, and in Italian Calamita, hath two marvelous great and secret properties, or vertues, the one to draw steele or Iron unto it, and the other to shew the North and South part of the world, of which stones some be of more force then others according to the place from whence they come. For those are counted best which are found in the East Indies, upon the coast of China and Bengala, which is no shell but a whole stone of sanguine colour like to Iron, and is firme, massy, and heavy, and will draw or lift up the just weight of it selfe in Iron or Steele. And as Norman saith in his new Attractive, such stones are commonly sold for their weight in silver.

Next to this Norman commendeth the red stone of Arabia, he commendeth also the stone of Almayne, which is in colour like to Iron, but spungeous, and thereby lighter then the other. And

as

as for the black and white stone of Elba, which is an Iland, not farre from Piombino, he saith the vertue thereof is but of small force, and of no long continuance: But the worst are those that come from Norway, whose colour is mixt with gray. I have heard that there be of them here in England, but how good I know not, it is marvell that Norman maketh no mention thereof, whose Treatise called the new Attractive, together with M. Borough his Addition, I would wish all that be studious in this Art to read most diligently, for truly in mine opinion the secrets of this Stone and variation of the Compasse, was never better disciphered, nor by more experiences tried then it hath bene by these two men last named. The booke is most necessary for Navigation and of an easie price, meete for every poore mans purse, though perhaps, in some points, not meet for every mans understanding. Now whensoever the wyars are to be touched with this stone, they must be made very cleane and void of all rust, to the intent that the Iron may the more firmely receive ỳ vertue of the stone. And it is well knowne by good experience that by vertue of the Loadstone, the North point of the Compasse declineth alwaies from the true North, either to the East or West, more or lesse according to the latitude of the place wherein you are, unlesse you be right under the Meridian of the Azores. And therefore most men in these parts of the world, do use to set the North point of the wyars not right under the Flower de Luce, signifying the North part of the World, but rather somewhat inclining toward the East, halfe a point or thereabout to avoid the Northeasting and Northwesting of the Compasse, the cause of which declination by divers learned men hath bin diversly taught, but not rightly as Michael Cognet saith, until Mercator found out the true cause, who first learned by the experience of one Francis of Deepe, an excellent Pilot, that in sailing under the Meridian which passeth thorow the Iles called the Azores, the needle doth decline neither East nor West, wherupon Mercator by calculating the variation of the Compasse at Ratisbone, found that ỳ Pole of the Loadstone ought to be put in that Meridian which passeth thorow the foresaid Iles, so as it may be distant frō the Pole of the world 16. deg. or rather as M. Borough saith 17.

fifteene degrees and twenty two minutes, and by that calculation Cognier hath found the variation of the Compasse at the Towne of Antwerp, to be 9 degrees. Item Master Borough by the new Instrument of variation first made by Robert Norman, and afterward perfected by himselfe, hath found the variation for London, to be 11 degrees and fifteene minutes, which is a whole point from North to East. But whensoever you depart from the aforesaid Meridian of the Azores, be it never so little, either toward the East or West, the Needle will vary and decline accordingly. And his greatest declination is when you come to a full quarter of that Parallell wherein you saile, for from thence it declineth lesse and lesse, untill you come againe under the foresaid Meridian, which thing Cognier doth plainely demonstrate, by this Figure here made of purpose.



In this figure the Letter A, which is in the very centre of the Circle of the North Pole, and the right line marked with the letters C, B, signifieth the Meridian which passeth through the Iles Azores, in which line is a point or pricke, marked with the letter, D, signifying the Pole of the Loadstone, distant from the North Pole fifteene degrees and a halfe. Now, if your ship be in the point B, then your Needle declineth on neither side, but pointeth

eth right to the North Pole, and also to the Pole of the Loadstone. But if you saile [illegible] to arrive to the point E, then the right line of the Earth is E, A, but your compasse sheweth on the right hand towards his owne Pole D, which is to the East, so much as the Angle A, E, D, doth shew. Likewise if you saile from B, Westward to the point F, the right line of the Earth shall be F, A, but your Needle will decline to his owne Pole D, toward the East, so much as the Angle A, F, D, doth shew. And to be short, the Needle doth never meete the right North, but onely in C, or in other places somewhat nigher that way you approach, the same your Needle declineth, and the more that you goe [illegible] of declining points. [illegible] Now when you are under the [illegible] Pole, then your Needle declineth neither East nor West, but then it standeth right North and South, as it doth in all other places of the Earth, when you are under the Meridian. Also this is to be noted, that the Needle in the Pole, and the Needle E, to signifie that [illegible] the Pole, and the Needle F, to signifie that [illegible] the Pole, [illegible] the Pole, [illegible] the Pole,

Chap. XXVI.

How to find out the variation of the Compaſſe by the Latitude.



Now I will ſhewe you how to finde out the variation of the Compaſſe, as well by the Sunne in the day time, as by the North ſtarre in the night ſeaſon. Firſt, make a marke at ſome point of the Eaſt, at the caſt point of the Compaſſe, and goeth beſide at the Eaſt North-eaſt point, that is to ſay, the Compaſſe is varied one whole point that is to ſay, the North point of the Compaſſe wandreth North and by Eaſt. Then ſeeing the Aire is cleare, and the riſing and ſetting of the Sunne, you may take with your Aſtrolabe the altitude of the Sunne in the forenoone, the ſame the better, at ſome iuſt point of the Compaſſe and take againe his altitude in the afternoone when he is in like degree of altitude, and marke likewiſe at ſome point of the Compaſſe the ſame altitude, and by the difference thereof you ſhall know the variation of the Compaſſe. As for example, you find by your Aſtrolabe or Croſſe ſtaffe, that the Sunne is ſo degrees high at the Southeaſt point of the Compaſſe, and obſerving the ſame againe in the afternoone you finde his highneſſe to be againe at the ſame Southeaſt point of the Compaſſe, whereby you ſee that the Compaſſe is varied one whole point, that is to ſay, the North point wandreth North and by Eaſt, and the South point is South and by Weſt. Yet teacheth it alſo another way, which is thus.

Take with your Croſſe ſtaffe or Aſtrolabe the height of the Sunne at noonetide, which is called the Meridian altitude of the Sunne, and thereby you ſhall have the true Meridian of the place where you are, with which Meridian if the South point of your Compaſſe doth agree, then your Compaſſe hath no variation at all, but if the South point thereof doe ſwerve or ſtrike on either ſide from the Meridian, marke how much it differeth, and

that

that difference will shew you the variation. Now to know the variation of the Compasse, by the North starre, doe thus, set your Compasse with the North starre, and if you finde them to agree then there is no variation, but note that this is to be done when the two guardes or pointers of Charles Waine are right over or right under the North starre, for if these two starres be West from the North starre, then the North star is a third part of a point unto the Eastward of the North Pole, and if the said two starres be right East from the North starre, then the North starre is a third part of a point unto the Westward of the North Pole.

The Compasse (as Bourne saith) doth vary most in sailing long voyages East and West, and though it vary two or three points, yet you may know what course to hold without alteration of the Wyers any manner of way. As for example, suppose the Northeast point to stand right North, and your course is to goe right West, here in this case you may use the Southwest point instead of the West point, whereby you may perceive that it maketh no great matter, which point standeth due North, so as you take that point of the Compasse for the North, which directly pointeth to the North. But Robert Norman and W. Borough by the helpe of their new inverted Instrument of variation doe shew how to finde out the variation of the Compasse much more exactly then ever it hath beene heretofore taught, which instrument together with the booke, I would wish all Seamen to have, and thereby to learne the perfect use of the instrument, which use that booke teacheth both plainely and learnedly, in which booke is also proved by divers demonstrations that there is no such attractive point as some have dreamed, but rather a respective point whereunto the Needle of your compasse will alwaies turne in what part of the world soever you saile. But of the place where that respective point should be, divers learned Pilots have had divers opinions, for some have imagined it to be in the heavens, and some above the heavens, if it were in the heavens then the Needle would daily turne about, and alter according to the motion of that heaven wherein the said point is, which is nothing so. And to be above the heavens, it is contrary to the old rule of Philosophy

...ology, which may put a certaine assurance to our, and others ...
...for Normandy. Later Voyages have great reason to give that ...
...it to the body of the earth being the Horizon, for they have ...
...tried by divers (very expert mariners) that the North part of the ...
...Needle of his owne accord and nature would alwaies decline ...
...to the East or Weast part of the compasse, or rather, as by ...
...their diligent observations they put it, the Declination of the Needle, to ...
...be the true or common Meridian, and by supposing the Altitude ...
...of the Pole at London to be 51 degrees 32 minutes, they affirme ...
...that according to that Latitude the Pole of the Loadstone being ...
...in the upper face of the earth, and right under the foresaid com-...
...mon Meridian, is 21 degrees 41 minutes distant from the ...
...Pole of the world, and the point respective to be drawne a ...
...right line from under the Horizon from London 71 degrees 50 ...
...minutes, and the variation of the Compasse to be as hath beene ...
...said before, 11 degrees and 19 minutes, but to move but the one ...
...place of the respective point in every Climate, they say, that no ...
...certaine Rules can as yet be recounted, by reason that the Com-...
...passe doth vary more sensibly in one place then in another, for in ...
...some place it will vary more in sayling 2 or 3 leagues then in an-...
...other place in sayling 100 leagues. As like, it will sometimes ...
...be retrograde, for by Borough in sayling between the North ...
...Cape and Vaigares towards the Northeast, and looking by his ...
...computation that the Needle should have increased his variati-...
...on towards the East, he found that it was suddenly turned back-...
...ward towards the West, notwithstanding doing both Norman and B. ...
...Borough use all the meanes they could, although the Compasse vary in several ...
...Horizons several variations, yet in any one Horizon the Nee-...
...dle alwaies respects one onely point without alteration, and ...
...that in his declining from the like point and that certainely ...
...in every place. And although the Needle of the Compasse by rea-...
...son of the weightinesse of the fly cannot decline downwards ac-...
...cording to his owne property, but onely the vertu the point re-...
...spective alwaies upon the Horizon, which vertu, as they say, ...
...is most certaine for sayling by, yet by sayling meanes and con-...
...tinuall as are not subiect in the foresaid broke, a diligent Pi-...
...lot having with him a perfect Globe may by true observati-...

ons

ons find out the increasing or decreasing of the declination of the Needle, which declination you shall find, as they thinke to bee more or lesse according as the point respective is more or lesse distant from the place whereas the triall is made, which being diligently observed in sundry places, with the certaine variation of the Needle from the Meridian, the true place of the point respective may be found out as they thinke.

But there be three causes which move me to think that the respective point will never bee truely found out. First, for that the Meridian, which in these dayes is supposed to be the first Meridian passing through the Azores, and especially through the Iles S. Marie, and Saint Michael, is not that Meridian under which the Mariners Compasse doth rightly point, as wel unto the Pole of the lodestone, as also to the North Pole of the World, for though Francis of Deepe found it so by his Compasse, yet divers learned Pilots since his time having sailed under that Meridian have found the variation of their Compasse to be as much there as else where, and not rightly to point to the respective point, which is supposed to be upon the earth, and without such a certaine Meridian no true account from any Latitude can be made. The second cause which moveth me to thinke as before, is for that the Compasse in some places of the Sea will be suddenly retrograde, which thing Master Bourough by his owne experience affirmeth to be true, as is before set downe. The third cause is, for that I doe verily beleeve, the finding out of the true place of the respective point, to be as great a secret in Nature, as it is to know the cause why the Loadstone should have such vertue to draw steele unto it, and to shew the North-Pole of the World, which are two secret gifts given to that stone of God, for mans behoofe, and yet the cause thereof is not to be found out by man, though most carefully sought by the greatest Philosophers that ever were.

Chap. XXVII.

Of the Mariners Card, and of the making thereof.

The Mariners Card, which some call a Nauticall Planisphere, is none other thing but a description made in Plano upon paper or parchment of the places that be in the Sea or in the land next adioyning to the Sea, as Points, Capes, Bayes, Ports, Floods, Ilands, Rocks, Sands, and such like: And such Cards are either universall or particular: the universall Cards are those wherein are described the most parts of the World, such as is the universall Card or Map of Mercator, or of Plancius. The particular are those wherein some speciall parts of the sea and land are described. And both these kinds of Cardes are traced with certaine lines, whereof some are called Meridians, some Parallels, and some the Lines of the Mariners Compasse shewing the 32 winds before described in the beginning of this Treatise. The order of making which Cards in times past was wont to be thus.

First, draw with a paire of Compasses a secret circle that may be put out, so great as you shall thinke meet for your Card, which circle shall signifie the Horizon, then divide that Circle into foure equall quarters, by drawing two Diameters crossing one another, in the Centre of the foresaid Circle with right Angles, whereof the perpendicular line is the line of the North & South, and the other crossing the same is the line of the East & West, at the foure ends of which crosse Diameters, you must set downe the foure principall winds, that is, East, West, North, & South, marking the North part with a Flower-delice in the toppe, and the East part with a Crosse, as you may see in the Figure following: Then divide every quarter of the said Circle with your Compasses into two equall parts, setting downe pricks in the middest of every quarter, thorow which pricks, and also thorow the Centre of the Circle, draw two other Crosse lines, which must extend somewhat beyond the circumference of the horizon, which two crosse lines together with the two first Crosse lines shall divide

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vide the Circle into 8 parts, and thereby you shall have the eight principal windes. That done, divide every 8 part of the said Horizon into two equall parts by drawing other two Crosse-lines through the Centre, and extending somewhat beyond the Circumference of the Horizon as before, whereby the whole Circle shall be divided into 16 parts, which shall suffice without making any more divisions, which would cause a confusion of lines, and at the end of every one of these 16 lines you must draw a little Circle, whose Centre must stand upon the circumference of the Horizon, every one wherof must be also divided into 16 parts by helpe of the 16 lines, diverslie drawne from the Centre of one little Circle to another, in such order as the Figure here placed more plainly sheweth to the eye, then I can expresse the same by mouth. And these little Circles doe signifie 16 little Mariners Compasses, the lines thereof signifying the windes, doe shew how one place beareth from another, and by what wind the ship hath to saile. But besides those little Circles there is wont to be drawn also another Circle somewhat greater then the rest upon the very Centre of the Horizon, which Circle by reason of the 16 lines that were first drawne passing through the same is divided into 16 parts, and the Mariners doe call this Circle the mother Compasse.

Here place the Mariners Card.

Chap. XXVIII.

The shape and figure of the first lineaments of the Mariners Card drawne after the old manner, and how to set downe the places of the land or sea therein.

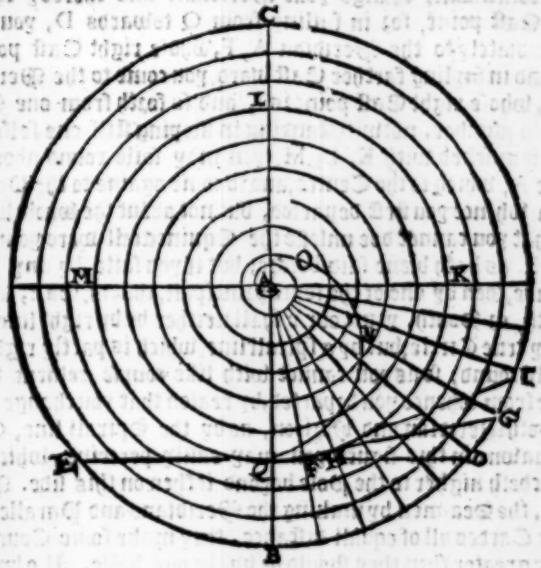
NOw the true setting downe of the places in the Mariners Card, as Points, Capes, Bayes, Flouds, Ilands, and such like, is to be done, by knowing what latitude & longitude every place hath, which is to be learned either by moderne Tables made of purpose: for the ancient Tables make no mention of any Lon-

gitudes or Latitudes of such places as are in the new found Land, which Land to them was never knowne, or else by such Mariners Cards already made as doe shew the true Longitudes and Latitudes of those places which you will describe in your Card, of which Longitudes and Latitudes, and especially the Longitudes of the places in the West Indies, few or none as are yet truely set downe.

Moreover, to know the distance of places, that is, how many leagues or miles one place is distant from another, there is wont to be set downe in the Mariners Card, a scale, otherwise called by the Mariners a Trunk, the making wherof is plainly taught by Martin Cortes in his Art of Navigation, in the second chapter of his third booke, and also how to graduate the Cardes, to shew what latitude every place hath, & there also he teacheth how to translate one Card to another, and how to reduce a greater Card into a lesser, and contrariwise. To which booke I referre you, and the rather, for that it is in English, translated many yeares since, out of Spanish by M. Richard Eden.

But for as much as the Seas, and the earth doe make together one whole round body, the lines of the 32 Rumbs in the Card being drawne right, & made, do signifie great Circles, can never shew the true course y^t ship hath to hold, which Michael Cognite proveth by a figure demonstrative, and thereof gathereth three conclusions. First, that a man may saile right North and South round about the World, if the Sea in all that course be Navigable, and so returne againe to the Port from whence he first departed. Secondly, that making the Equinoctiall his Parallell he may saile East and West round about the World, and so returne to the Port from whence he departed, also if he saile East and West in any other Parallell that is distant from the Equinoctiall he may returne by the same Parallell to the Port from whence he first departed, and yet not about the whole world, for that cannot be done, but only when the Equinoctiall is his Parallel. Thirdly, that whosoever saileth by any other Rumbe then by one of the foure principall, he by often changing his Meridian and Horizon must needs saile by a line Spirall, which is neither perfectly right, nor perfectly round, and thereby he may well approach

proach the Pole, and alſo goe round about it, but yet with unequall diſtance, ſo as he ſhalbe nigher beyond it then on this ſide, by meanes whereof he cannot returne to the place from whence he came, as you may plainely perceive by this Figure demonſtrative here placed.



In which Figure the letter A doth ſignifie the North Pole, and the letters B C the Meridian paſſing through the Pole A, then ſuppoſe your ſhip to be in Q, whereas the Pole is elevated 30 degrees: and Q to be your Zenith, and the right line E, Q, D, to be your right line of Eaſt and Weſt cutting the foreſaid Meridian with right angles, and let D be the Eaſt point and E the Weſt point.

Now you may ſaile from Q towards the North with a South-winde, and from A you may ſaile againe South-ward

with a North winde untill you come to the South Pole, and from thence you may saile againe North-ward with a South wind untill you come againe to Q, from whence you first departed, and so you shall have gone round about the world under one selfe Meridian A,B,C. But in sailing East or West, you shall continually change your Meridian, and thereby change your East point, for in sailing from Q towards D, you come immediately to the Meridian A, F, whose right East point is G, and in sayling farther East ward, you come to the Meridian A,H, whose right East point is I, and so forth from one Meridian to another, notwithstanding in keeping still one selfe Parallell marked with K, L, M, you may saile round about the Pole A, which is the Centre, and so come againe to the Port Q, from whence you first departed, but not about the whole world: for that you cannot doe unlesse the Equinoctiall were your Parallell, as hath beene said before; but if you saile by any other Rumbe, then by one of the foure principall, that is, East, West, North, or South, your course shall neither be by right line, nor yet by true Circle, but by a spirall line, which is partly right and partly round, so as you cannot with like course returne to the place from whence you departed, by reason that you change so often both Meridian and Horizon, as by the Spirall line, Q, N, O, drawne in this figure you may easily perceive, which approacheth nigher to the Pole beyond it then on this side. Moreover, the Sea-men by making the Meridians and Parallells in their Cardes all of equall distance, they make some Countries farre greater then they should be by the one halfe. Also by that meanes he that saileth East and West round about the Pole in the Parallel whose latitude is 60 degrees, should make as long a voyage as he that saileth East and West along the Equinoctiall, the voyage whereof is twice as long as the other, for the redresse and remedy of which faults, Cognict hopeth to finde out some more perfect Rule of making Cards when opportunity of time shall serue: in the meane time to reforme the said faults, Mercator hath in his universall Card or Map made the spaces of the Parallels of Latitude to be wider every one then another from the Equinoctiall towards either of the Poles, by what Rule

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I know not unleſſe it be by ſuch a Table, as my friend Maſter Wright of Caius Colledge in Cambridge at my requeſt ſent me (I thanke him) not long ſince, for that purpoſe, which Table with his conſent, I have heere plainely ſet downe together with the uſe thereof: as followeth.

Heere muſt you place the Draught of the Meridians and Parallels of the Mariners Card.

Chap. XXIX.

A Table to draw thereby the Parallels in the Mariners Card, together with the vse thereof in truer sort then they haue beene drawne heretofore, and the vse thereof.

Degrees of the Meridian beginning from the Equinoctiall circle.	Equall parts of the Meridian in the Mariners Card, of which parts euery degree of the Equinoctiall containeth 60 miles.	Degrees of the Meridian beginning at the Equinoctiall circle.	Equall parts of the Meridian in the Mariners Card, of which parts euery degree of the Equinoctiall containeth 60 miles.
1	60	25	1551
2	120	26	1617
3	180	27	1684
4	240	28	1752
5	300	29	1820
6	361	30	1889
7	421	31	1959
8	482	32	2029
9	542	33	2100
10	603	34	2173
11	664	35	2245
12	725	36	2319
13	787	37	2394
14	849	38	2470
15	911	39	3546
16	972	40	2624
17	1035	41	2703
18	1098	42	2783
19	1162	43	2865
20	1225	44	2948
21	1289	45	3032
22	1354	46	3118
23	1419	47	3205
24	1484	48	3294

Degree

Degrees of the Meridian, &c.	Equall parts of the Meridian, &c.	Degrees of the Meridian &c.	Equall parts of the Meridian, &c.
49	3385	65	5189
50	3477	66	5331
51	3572	67	5482
52	3668	68	5639
53	3767	69	5804
54	3868	70	5976
55	3972	71	6156
56	4078	72	6346
57	4187	73	6547
58	4299	74	6759
59	4414	75	6985
60	4532	76	6226
61	4655	77	7484
62	4781	78	7764
63	4911	79	8067
64	5046	80	8399

THe vse of this Table for making the Sea Card is thus. Ouer-thwart the middest of the Plaine superficies, wherein you would draw the lineaments of the Card, describe a right line marked with the letters A, B, C, whereof B is the verie middest Centre, and this line representeth the Equinoctiall, the end whereof on the right hand, marked with the letter C signifieth the East, and the other end on the left hand marked with the letter A signifieth the West, which Equinoctiall line must be deuided into 360 degrees, then crosse the same squirewise with perpendicular lines, passing through euery tenth or fifth degree, as you see in the example following. then take with your Compasses the length of halfe the Equinoctiall, that is 180 degrees, and set one foote of your Compasse in the mutuall intersection of the Equinoctiall, and of that perpendicular or Meridian, which passeth through the East end of the Equinoctiall line, marked with the Letter C,

and

and with the other foot make a pricke in the same perpendicular or Meridian, and marke that pricke with the letter D; that done, divide the space contained betwixt this pricke and the Equinoctiall first into three equall parts, and every one of those into other three equall parts, so have you 9 parts. And again every one of those into three, so have you twenty seven parts, & divide every one of those parts into foure parts, so shall you have a hundred and eight parts, and if there be space enough, divide againe every one of those into ten, so shall you have 1080 parts, and if it be possible, divide againe every one of those parts into other 10, so shall you have in all 10800 parts, but this can hardly bee done, unlesse the Card be very large, wherein every degree of the Equinoctiall is neere an inch long, which happeneth very seldome, and therefore 1080 parts shall suffice.

And for the easier numbring of these parts, set to them Arithmeticall figures with black lead, which may afterward be put out when your worke is done, beginning at the Equinoctiall and so proceed from thence both Northward and Southward, then look what number standeth right against every degree in the former Table, which degrees doe extend from one to foure score degrees, and omitting alwaies the first figure on the right hand of that number which you find, for so you must alwaies doe when your division containeth no more but 1080 parts, count that number which remaineth upon the line of division, & there make one pricke, and make another pricke of the same distance from the Equinoctiall upon the uttermost Meridian on the left hand, through which two pricks draw a right line, and that shall bee your first Paralell of Latitude, and so proceed with all the rest, first Northward, and then Southward, if you minde to make an universall Card. But the example following containeth no more but the one halfe of an universall Card proceeding from the Equinoctiall line Northward unto the 80 degrees of Latitude: for further Northward then 80 degrees is no land as yet discovered or knowne, nor yet all that, so farre as ever I could learne.

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Chap. XXX.

The draught of the Meridians and Parallels of the Mariners Card, or Nauticall Planiſpheare, according to the former Table.

IN this laſt Figure or Table is firſt drawn (as you ſee) the Equinoctiall line marked with the letters, A, B, C, and that line is divided into 360 degrees, and therein alſo are drawne perpendicular lines, as well through the beginning and ending of the ſaid Equinoctiall line, as alſo through every tenth degree thereof, which be the Meridians, and are every whe re equidiſtant each one from other, then take halfe the length of the Equinoctiall, which is A, B, or B, C, with your Compaſſes, and ſetting one foote in the end of the Equinoctial marked with C, make with the other foote a pricke at D, in the Meridian or perpendicular line marked with the letters C, D, E: then divide the ſpace contained betwixt C, and D, into 1080 parts in ſuch ſort as before hath bin ſhewed, and ſet the figures unto them, as heere you ſee, to the intent that you may the more readily number the parts. Then looke in the firſt Table what number anſwereth to every 10 degree of the Equinoctiall, and caſting away the firſt figure of that number on the right hand, ſtand out the parts anſwerable to the number remaining in the line C, D, and at thoſe parts ſet pricks in both the outward Meridians, through which pricks you ſhall draw the Parallells. As for example, in the firſt Table you ſee that the number right againſt 10 degrees is 60, (the firſt figure 3 towards the right hand being reiected) therefore looke 60 in the line C, D, and by that part draw the firſt Parallell diſtant 10 degrees from the Equinoctiall, And after this manner all the reſt of the Parallels are to be drawne.

Many doe uſe to paint the vacant places in the Cards with ouer many things, and the Compaſſes thereof with diuers and ſuperfluous colours which William Bourne miſliked, wiſhing that inſtead thereof, they would ſhew by letters or other Charac-

ters,

ters what Moone doth make a full Sea, in such places as are necessary to be knowne, and also to draw the true shape and fashion of every Cape or Head-land, that is needfull about the Coast, and at what point of the Compasse the land riseth of this or that fashion, for being neere the land it will seeme to be of one fashion, and being farre off to be of another fashion, and to mistake any place on the Sea is very dangerous to the Mariner. But above all things let him that saileth by Card and Compasse, be sure that the Needle of his Compasse, have the like declination that his needle had, which made the Card. For Cognet reporteth that certaine Mariners, being in the West Indies, and seeing the North starre to be North-east, marvailed thereat very much, not knowing the cause of that error, which indeed was for that the Needle of their Compasse was made to decline North east, whereas it should rather have declined Northwest, for the West-Indies do stand Westerly from the Azores. It is necessary also to set downe in the Card such places as are dangerous, as Sands, Flats, Shoulds, Rocks, and such like things as are not alwaies to be seene with the eye, to the intent that the Mariner being advertised thereof, may shunne the same. All which things before mentioned, Wagoner hath in all places contained in his booke very well observed. Thus having spoken sufficiently of making the Mariners Card, now I think it good to shew the most necessary and chiefest uses thereof.

Chap. XXXI.

The chiefest uses of the Mariners Card.

The chiefest uses of the Sea Card are these foure here following.

The first is to know thereby how that place whereunto you would saile, beareth from the place or Port from whence you set off, or depart. And that is to be known by the lines of the Mariners Compasses, drawne in the Card, in this manner fol-

following: Take a paire of Compasses, and having opened them, set the one foot thereof in the very place from whence you depart, and the other foot in the next line of that Compasse, which is nearest unto your place of departing, I meane such a line as doth most rightly direct you to the place to which you would goe, and your Compasse being opened at the fit wideneſſe to serve that line, draw them from the place of your departing, unto the place whereunto you would goe, suffering the foot of the Compasse which standeth upon the line of the wind, whilest you draw it forward, not to swerve one jot from that line, and that line will either rightly direct you to the place assigned, or fall short therof, or else over-reach the same; if it fall short, then take another line nære to the place from which you departed, and if it over-reach, take some line that is farther off from the place of your departing: having found out a line that pointeth directly to the place, consider what winde or Rumbe it is, for by that wind the place assigned beareth from you, and the Rumbe or wind opposite to that is the wind, whereby you have to saile.

The second use is to know by the Card, how farre the place whereto you go is distant from the place of your departing, which is done by help of the scale or trunk set downe in the Card, thus: Take the iust distance betwixt the two places with your Compasses, by setting the one foot in the one place, and the other foot in the other place, and apply that wideneſſe of the Compasse to the scale or trunk, and the trunk will shew how many leagues the one place is distant from the other, and if the distance betwixt the places be longer than the trunk, then take first the length of the trunk with your Compasses, and look how many times that is contained in the space betwixt the two places, and if there do remaine any odde measure, then, having taken that odde measure with your Compasse, by setting them at such wideneſſe as is answerable to that odde measure, apply that wideneſſe to the first part of the trunke, so shall you know the just measure of the whole. And this Rule serveth to take the true distance of any other two places whatsoever set downe in the Card.

The third use is to know by the Card what Latitude or Altitude of the Pole any place set downe in the Card hath, which is done

done by helpe of the line of degrees of Latitude, otherwise called the Graduation of the Card, in this manner following: Set the one foot of your Compasses in the very place whereof you would know the Latitude, and the other foot in the line of East and West, which is nert unto that place, and keeping that foot still upon that line, draw your Compasses forward untill you come to the line of degrees, and marke what degree of the said line the foot of the Compasse, which was first set in the place, doth crosse or touch, for that is the degree of Latitude for that place, numbring from the lowest degree of Graduation upward, so shall you find the Latitude of Lisbone in Portugal, by Mercator his universall Card, and by the Card set downe in Martin Cortes Booke, and also by Medina his Card, drawne in his booke of Navigation, to be 38 Degrees, 30 Minutes and somewhat more. But by the Tables of Ptolemie you shall finde it to bee 40 Degrees, 24 Minutes, and by Appian his Tables to be 39 Degrees, and 38 Minutes.

The fourth use chanceth when you are driven out of your right course by stormes or tempest, which stormes how to foresee and to prognosticate, is plainely taught by Martin Cortes in the 19 Chapter of his second Booke. Also you may be driven by force of contrary winds, by surging of the Sea, or by overthwart Tides, Currents, and such like impediments, so as you cannot lay your course right to the place assigned, for remedy whereof you must seeke in what place you are, and to note the same in your Card, which as the Mariners terme it, is to make a prick in the Card, which to doe truely in time of need, many things are to be knowne and well observed, and kept in memory. First, to know what Latitude the place from whence you first departed hath, then to keepe in mind what way your ship did make good at every shift of winde, that is to say, how many leagues, and in how long time you sailed by every severall wind: and then not knowing well where you are, nor how farre you are distant from the place whereunto you would goe, learne to know by helpe of your Astrolabe or Crosse-staffe, in such sort as is before taught, the altitude of the Pole in that place where you are, which if you finde to be all one with the Latitude of the place of

your

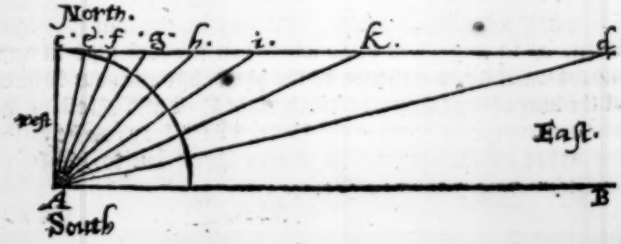
your departure, then you may assure your selfe that you have sailed by the line of East and West without altering your Latitude, but if you finde the Latitude of the place where you are to be more or lesse then the Latitude of the place from whence you departed, then resort to your Card, and take two paire of Compasses opened at such wideneſſe as the one foot of the one Compasse may stand in the place from which you departed, and the other foote of the same Compasse to stand in the line of the Rumb whereby you sailed: and let the one foot of the other Compasse stand in that degree of Latitude which you last found, and the other foot of the same Compasse in the next line of East and West, and holding the Compasses so ordered in each hand one paire: draw them both so as they may meet together, taking good heed in drawing them, that the foot of that Compasse which was placed in the line of the wind, may at no time swerve from that line, nor the one foot of the other Compasse to swerve from the line of East and West, wherin it was first placed, and wheras the two feet of those Compasses doe meete, that is to say, that foot of the one Compasse which was drawne from the place of your departing, doe meete with that foot of the other Compasse, which came from the degree of Latitude last found, where these two feet (I say) do meet, there make a pricke, or marke, in your Card, for that is the place where your ship is at that instant. And from thence you must take your right course againe to the place where unto you would goe. But because it is necessary as well at this time as at all other times, to know what way your ship hath made, and that the same is not, in mine opinion, so plainely nor so commodiously taught by any one that I have read, as by Michael Cognet, I minde therefore in the two Chapters next following, to set downe his way, not only how to find out the way of your ship, when you saile South or North under one selfe Meridian, or in any other place where you are to change in your gate the Latitude or Altitude of the Pole, but also how to finde out the way of your ship in sailing right East and West, without changing the Altitude of the Pole, which way, as he saith, was never heretofore knowne to any Pylot but to himselfe, first Author and Inventor thereof.

CHAP.

Chap. XXXII.

How to know the way of your ſhip, and how many Leagues are to be counted for one degree in Latitude of euery Rumbe whereby you ſaile.

FIrſt you haue to underſtand that in ſailing iuſt North and South, you doe alwayes abide vnder one ſelfe great Circle, called the Meridian, vnder the which, when you haue ſailed ſo farre as the Altitude of the Pole is changed one degree, then haue you gone 17. Spaniſh Leagues, and a halfe: and you haue to note that euery Spaniſh league containeth 2857 fathoms, and that our Engliſh league containeth no more but 2500 fathoms, ſo as the Spaniſh league is more then our Engliſh league by 357 fathoms, and euery fathome containeth ſix foote. Againe in ſailing Eaſt and weſt, you doe alwaies remaine vnder one ſelfe Parallell, by meanes whereof the Altitude of the Pole doth neuer alter, and therefore no true account can be made of the leagues, but by ſuch meanes as Cognet teacheth in the Chapter following. But if in ſailing North & South you decline one Rumbe, either towards the Eaſt or Weſt, and goe ſo farre as the Altitude of the Pole is changed by one degree, then you haue made ſomwhat more then 17 Spaniſh leagues and a halfe, and to be ſhort, the more Rumbes that you decline towards the Eaſt or Weſt, the more Leagues in number doe belong to one degree of Altitude, as you may plainely ſee by this figure demonſtratiue heere following, in which the letter A ſignifieth the place or point in the Card, from which you depart, ſituated in the Parallell A, B.



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Then suppose C, D, to be another Parallell, equally distant from A, B, by one degrée of altitude. Now if you saile right East or West, then you shall alwaies remaine in the Parallell A, B, equally distant from the Pole. But if you saile from A, right North, so farre as the altitude of the Pole is augmented one degrée, then your ship shall be in C, and if you saile by the first Rumbe towards the East, so farre as the Pole doth alter in altitude one degrée, then your ship shall be in E, and thereby your way must nœds be longer, and so consequently the more Rumbs you decline from North to West, the longer is your way, and the more Leagues must be accounted to one Degrée of altitude, as the lines drawne from A, to E, F, G, H, I, K, and D, doe shew. And whatsoever is said here of the quarter from North to East, the same is to be understood in all the other three quarters, that is, from North to West, from South to East, and from South to West. But if you will know how many Leagues doe belong to every degrée, according to the Rumbe whereby you saile, then consider well this Table here following.

The first Table.

For in sailing from North or South, towards East or West, so farre as you come to change one degrée of altitude of the Pole, the said degree doth require for the first Rumbe, &c.

Rumbes.	Leagues.
1	17 $\frac{5}{6}$
2	18 $\frac{14}{17}$
3	21 $\frac{9}{17}$
4	24 $\frac{3}{4}$
5	31 $\frac{1}{2}$
6	45 $\frac{1}{2}$
7	89 $\frac{2}{3}$

Now then to know how much way you have made in sailing, you must first know as well the Latitude of the place from which you departed, as of that place whereunto you be arrived: then by the foresaid Table seeke to know how many Leagues doe belong to a degrée of that Rumbe whereby you have sailed, for in multiplying the number of the Leagues by the degrées of the difference of the two Latitudes, the product therof will shew you how many Leagues you have sailed, notwithstanding

ſith the way may be made longer or ſhorter by changing or ſhifting of the wind, it is needfull that the Pilot have conſideration thereof, who by ſkilfull coniecture must ſometime, either adde to or take fro, according as need ſhall require. Moreover, by the foreſaid figure marked with letters, you may alſo eaſily underſtand how much you change in Longitude, that is to ſay, how much you are diſtant from the Meridian of that place from whence you departed, be it either towards the Eaſt or Weſt, for he that ſaileth from the point A, as is aforeſaid, right North or South, he remaineth alwaies under one ſelfe Meridian: but he that ſaileth by the firſt Rumbe towards the Eaſt or weſt, ſo farre as he changeth one degrée of altitude, and arriveth to the point E, is now diſtant from his firſt Meridian, ſo much as the ſpace betwixt C, and E, which we find by computation to be three leagues and a halfe for one degrée of Latitude, which amounteth to 12 minutes of a degrée, and ſo of the reſt of the Rumbs, as appeareth by this Table here following.

The ſecond Table.

Rumbs.	Leagues	Degrees & minutes of longitude.	
firſt	3 1/3	0	2
ſecond	7 1/4	0	25
third	11 5/7	0	40
fourth	17 1/2	1	0
fifth	26 2/7	1	20
ſixth	42 3/4	2	25
ſeventh	88 0	5	2

For in ſailing from North or South towards Eaſt or Weſt ſo farre as you change one degrée of altitude of the Pole, you change alſo your Meridian, and thereby your longitude, the quantity whereof anſwerable to every Rumbe is ſet downe on the right ſide of this Table.

And to make this more plaine by example, ſuppoſe that you ſayle from Liſbone, which is a famous Port in Portugal, by the wind Southweſt and by weſt, which is the fifth Rumbe from South to Weſt, ſo farre as you find the altitude of the Pole to be 18 degrées leſſe than at Liſbone. Now if you would know how many leagues you have ſailed, & alſo how much the Meridian of that place is more weſtward then the Meridian of Liſbone, then doe thus: Looke in the firſt Table, and you ſhall find that to one degrée of the fifth Rumbe do belong 31 leagues and a halfe, which

leagues

leagues being multiplied by 18, doe make in all 582 Leagues and $\frac{1}{4}$, which you have sailed. Then looke in the second Table, and you shall find for the fifth Rumbe one degree and 30 minutes of Longitude which being multiplyed by 18 and a halfe, doe make 27 degrees and $\frac{1}{2}$ of a degree, for by so much is Lisbone more Eastward than the place where you are. And whereas the first Table is made according to the proportion of right lines, such as are commonly drawne in Mariners Cardes, Coginet maketh another Table according to the proportion of circular lines, which for that it differeth very little or nothing from the first table, I omit here to set it downe. But now because the first Table doth chiefly serve those that saile either East or West in any Parallell betwixt the Equinoctiall and the 60 degree of Latitude or Altitude of the Pole: and that from thenceforth by reason that they saile by more oblique and spirall Circles doe make the longer voyage, Coginet thought good to adde a third Table shewing how many leagues are answering to one degree of altitude to those that saile either East or West, in any Parallell that is betwixt the Pole and the 60 degree of Altitude, which Table differeth not much from the others in the first foure Rumbs, but in the three last, that is in the 5, 6, and 7 Rumbe it differeth greatly, and most in the seventh, as you may easily perceive by comparing this and the first Table together.

The third Table.

	Deg.	M.		Leagues.	
The first Rumb hath	1	1	Which according to the proportion of 17 leagues & a halfe for one degree doe make for every Rumbe so many leagues as this Table sheweth.	17	$\frac{19}{24}$
the second Rumb	1	5		18	$\frac{23}{24}$
the third Rumb	1	12		21	0
the fourth Rumb	1	22'6		25	$\frac{1}{12}$
the fift Rumb	1	50		32	$\frac{1}{12}$
the sixt Rumb	2	42		47	$\frac{1}{2}$
the seventh Rumb	5	44		100	$\frac{1}{2}$

Chap. XXXIII.

How to account the Leagues in sailing directly East or West, without changeing the latitude or altitude of the Pole.

IN sailing right East & West, you continue still in one selfe Parallell without making any change of Latitude. Most men therefore think it is impossible for you to make any true account of the Leagues, but only by coniecture, for remedy whereof Cognier hath invented a Rule most certaine, as he saith, the foundation whereof is thus. First you must suppose the Meridian of that place, from whence you depart, to be a firme and fixed point, and to be the very beginning of that Parallell wherin you saile, then you must know what houre is aswell at the place from whence you first departed, as also at the place whereunto you are arrived, and having the difference of the houres, you must know how many leagues every houre yeldeth according to the Parallell of that altitude of the Pole under which you saile, so shall you easily know how many leagues you have sailed. This foundation being first laid, Cognier setteth downe this generall Rule in this manner following: whensoeuer you have to saile (saith he) right East or West, you must first provide your selfe of these two things, the one is of an Astronomicall Ring that may justly shew the houre at any time: Instead whereof I thinke it better to have an universall Diall, such a one as is described by William Bourne in the one and twentieth Chapter of his Regiment: the other thing is to have a true Houre-glasse that will run continually foure and twenty houres, and therefore had need to be three times more long and large then common Houre-glasses be, whereof the Glasse-makers can quickly prouide, and because the ship leaneth sometime on the one side, and sometime on the other, it shall be needfull to hang the

said

said houre-glasse with Rings of Glasse or Latten, to the intent that it may alwaies hang levell like as the Mariners Compasses are wont to be hanged in their bores. Now being thus provided of these two instruments, you must at your departing prepare your Houre-glasse, that is to say, you must set it a running just at noone, when the Sunne is right South, not forgetting to turne it in your voyage once a day, in the very instant that it is ready to runne out. Then having sailed certaine daies, and being arrived at the place where you would know what way you have made, looke to your Houre-glasse, and tarry untill it be full runne out, at which instant seeke to know what houre it is by your Astronomicall ring, or rather by the universall Diall, for if you saile East, you shall finde it to be past noone, but if you saile West, then it will want of noone, and keepe those houres in minde, that you may know how much it is more or lesse then noone, for those houres by shewing the difference of the houres that are betwixt the Meridian of the place from whence you departed, and the Meridian of the place where to you are arrived, will certifie you with the helpe of this table here following, what quantity of way your ship hath made.

A Table to help you to know how way your ship hath made in sayling right East or West without changing your latitude, together with a briefe description and use thereof.

Degrees	Leagues	Degrees	Leagues	Degrees	Leagues	Degrees	Leagues
0	262	23	241 1/3	46	182 1/4	69	94 1/3
1	262	24	241	47	179	70	89
2	262	25	239	48	176 1/2	71	83 1/2
3	262	26	238	49	172	72	81
4	262	27	234	50	168 1/2	73	76 1/2
5	261 1/2	28	231	51	165	74	72 1/2
6	261	29	228 1/2	52	161 1/2	75	68
7	260 1/2	30	227 1/2	53	157	76	63 1/2
8	259 1/2	31	225	54	154 1/2	77	59
9	259	32	222 1/2	55	150 1/2	78	54 1/2
10	258 1/2	33	220 1/2	56	146 1/2	79	50
11	257 1/2	34	217 1/2	57	143	80	45 1/2
12	256 1/2	35	215	58	139	81	41
13	255 1/4	36	212 1/2	59	135	82	36 1/2
14	254 1/2	37	209 1/2	60	131	83	32
15	253 1/2	38	206 1/2	61	127	84	27 1/2
16	252 1/2	39	203 1/2	62	123	85	22 1/2
17	251 1/2	40	201	63	119	86	18 1/2
18	249 1/2	41	198	64	115	87	13 1/2
19	248 1/2	42	195	65	111	88	9 1/2
20	246 1/2	43	192	66	106 1/2	89	4 1/2
21	245	44	188 1/2	67	102 1/2	90	—
22	243 1/2	45	185 1/2	68	98 1/2		

This

This Table as you see consisteth of foure collumns, in euery one whereof are set downe on the left hand the degrees of Altitude of the Pole, and next to that on the right hand the Leagues, answerable to euery degree, the use whereof is thus: First, seeke out in the said Table the degree of altitude, belonging to that Parallell, vnder which you sailed, and next to that on the right hand you shall finde the number of leagues incident to that degree: which number of leagues, if you multiply by the number of houres before found, the product thereof will shew you how many leagues you haue sailed. And if there be any minutes annexed to the houres, then multiply also the number of the foresaid Leagues found in the Table by those minutes, and diuide the product thereof by 60, and the quotient shall be Leagues, which you must adde to the former leagues, and the summe thereof will shew how many leagues you haue in all sailed.

CHAP. XXXV.

An example of counting the way of your ship in sailing right West.

Suppose that you haue to saile from y Cape Saint Vincent in Spaine right West, and therfore you prepare your Houre-glasse as it may beginne to runne iust at noone, and hauing sailed eight or nine daies, (not forgetting once euery day, to turne your houre-glasse) you doe arriue at one of the Iles of the Azores called S. Marie, and there hauing tarried vntill your Houre-glasse be cleane runne out, and seeking to know at that instant by your Astronomicall ring, or by some vniuersall Dyall, what houre it is, you find that it is 11 of the clocke and 10 minutes past, which wanteth 50 minutes of iust noone, and that is the difference betwixt the two Meridians, that is to say, the Meridian of Cape S. Vincent, and the Meridian of the Ile of S. Marie, both which places being in one selfe Parallel, must needs haue one selfe Latitude or Altitude, which is 37 degrees, which Altitude being found in the Table in the

second column on the left hand, you find there also hard by it on the right hand 209 leagues, and ½ of a league, for every houre of that Parallell, which number of leagues, if you multiply by the foresaid 50 minutes, the product shall be 10487½, which if you divide by 60, you shall finde in the quotient 174 Leagues and ½ parts of a League, which is the just quantitie of your whole voyage.

CHAP. XXXVI.

Another example of counting the way of your ship in sailing right East.

Suppose then that you have to saile from the New found land right East in the Parallell of 50 degrees: and having caused your houre-glasse to begin to runne just at noone, you set forth and saile the space of 15 daies, not forgetting every day once to turne your houre-glasse. Now if at the 15 daies end, you would know how many leagues you have sailed, to finde in your Card in what place you are, you must first tarry untill your houre-glasse be cleane runne out, and at that instant take by your Astronomicall Ring, or by some universall Dyall, to know what houre it is, which because you have sailed right East, you finde to be two houres and twelve minutes afternoone, then resorting to the Table aforesaid, you finde in the third column the 50 degree of altitude, together with the number 168 leagues and a halfe, annexed to the said degree for one houre of that Parallell, which summe being multiplyed by two houres maketh 337 leagues, then multiply once againe 168 by the odde 12', and divide the product thereof by 60, so shall you finde in the quotient 33 leagues and somewhat more, which being added to the former summe 337 Leagues, will make in all 370 Leagues and a little more, and that is the true quantity of your voyage. And Cognier saith, that by practising this way of counting, you may know every day, yea every houre, what way your ship maketh in sailing East or West.

CHAP.

Chap. XXXVII.

To know how much you goe out of your way in sailing by one wrong Rumbe, or by more.

If in sailing many dayes you direct your course either too high or too low by one Rumbe, you lose in every hundred leagues 19 leagues and ½ of a league, so as you goe out of your way almost the fift part of your voyage, and if by two Rumbs, then in every hundred leagues you lose 38 leagues, that is to say, you goe so farre out of the right way: and if you fail three Rumbs, out of your right course, then in every hundred leagues you lose 58 leagues, and if you fail foure Rumbs, then you lose in every hundred leagues 76 leagues, and the more Rumbs that you mistake in your direction, the more you wander out of your right course. Thus much touching the Mariners Compasse and his Carde: now we will speake of the North starre, and of his guards, and then of the Sunne, and of the Moone, and so end.

Chap. XXXVIII.

Of the North starre, otherwise called the Loadstarre, and of his guards, and how to know the same.

Though every Mariner knoweth the Northstar so soone as he seeth it in the firmament, because it is his chiefe guide to direct thereby his ship in the right season in all the North parts of the world, yet every man that is no Sailer knoweth him not, and therefore minding here to treat thereof, I think it not amisse first to teach him how to know it, and in what part of the heaven it is placed, and how farre it is distant from the North pole.

The

The Poets doe faine that of the 48 Images of the fixed starres that be in the heaven, which are otherwise called Constellations, there be two Beares having tailes, whereof the one is called the great Beare, and the other the little Beare, in every of which are seven principall starres: and that bright starre which is in the very tippe of the little Beares taile, is commonly called of our English Mariners the Loadstarre, of the Latines Stella Polaris, of the Greeks Cinosura, and of the Arabians Alrucubi. But to finde this starre, you must first finde out the seven starres of the great Beare, by looking towards the North part of the firmament, of which starres, foure being placed in his body, doe make (as it were) a foure square, and the other three starres being placed in his taile, which is somewhat rising in the midst, doe represent the portion of a Circle, the little Beare hath also the like shape, saving that her fet and belly doe turne upwards, so as the tippe of her taile is answerable to the two hindermost starres of the great Beare, as you may see in these figures following.

Some doe call the great Beare great Charles Wain or Wagon, and the little Weare, little Charles Wain because in each figure the foure square starres doe signifie the foure wheeles, and the other three starres the three horses: Now to finde out the Loadstarre, imagine a right line to passe thorow the two hindermost starres otherwise called the guards or pointers of the great Beare, as you see here in this figure, that line will rightly direct your eye to the



Loadstarre

Loadstarre which standeth in the tippe of the little Beares tale, for there is no bright star that can be seen betwixt the two guards of the great Beare and the Loadstar. Notwithstanding some doe affirme that there is another star nigher unto the Pole, then the foresaid Loadstarre, and that starre is, as they say, no more but 30 minutes distant from the Pole: I have heard that there is a Priest an Astrologer with the King of Denmarke, who is wont to find out this star by the helpe of an Instrument, whereby he setteth still the sight of six other Starres in one instant, which (my I feare me) is more troublesome then profitable, and if there were any such Starre inward, and therewith so needfull and meet to be used, as is the Loadstarre, I doubt not but that some of our learned Pilots would have found it out, and also have had some use thereof long ere this time. But leaving this matter I will returne to the description of our Mariners common Loadstarre, and shew of what bignesse it is: also what Longitude, Latitude, Declination, and Motion it hath, and finally the chiefest and most necessary uses thereof.

This Starre according to the Ptolemicall Tables, is of the third bignesse: and in Longitude hath 53 Degrees, 30 Minutes, counting from the first Starre of the Rams horne, whose place in these our daies is in the 27 Degree, 30 Minutes of Aries, and by this meanes the place of Longitude of the Loadstarre, or Polestarre, is in the 21 degree of Gemini, and his Latitude counting from the Ecliptique line towards the North Pole of the Zodiaque is 66 Degrees, 0 Minutes, and his Declination counting from the Equinoctiall towards the North Pole of the world is 86, so as he is in these daies distant from the North Pole 4 Degrees, some say 4 degrees and nine Minutes, but Cognier saith, that he is distant from the Pole but 3 Degrees and a halfe, who findeth by the Astronomicall Tables that this Starre, at the birth of Christ, was twelve Degrees 36 Minutes distant from the Pole, and ever since hath gone decreasing, and shall decrease every day more then other, untill it come to be 26 Minutes distant from the Pole, which is as nigh as it can approach to the Pole, for then his distance shall beginne againe to encrease, it being already come so neare, as

it

it is not aboue two degrées 52 distant from the Pole. This Star maketh his daily reuolution from East to west, in 24 houres as all other Stars doe by vertue of the first moueable; but his circuit is so small, and his gate so slow, as in the space of 24 houres he goeth not much more then 24 degrées of the Equinoctiall, and in his turning round about he maketh as it were a little Circle, in the midest whereof is the North Pole it selfe, which is inuisible and cannot be seene.

And though the image or constellation of the little Beare containeth many Stars, yet the seuen before mentioned, and set forth in figure, are most obserued, of which seuen Starres in the little Beare, two Stars called the guards of the Northstarre, are to the Mariners most familiar, for diuers respects hereafter declared. And of those guards the one is Northern, and the other Southern, and both are said to be of the second magnitude, and yet the Southern guard seemeth to the eye both lesser and darker then the other. Of which two Stars, I think it not amisse to set downe here the longitude, latitude, and declination, as I haue done before of the Lodstarre.

The longitude of the South guard is 100 degrees, 30 minutes, whereby his place is in the ninth degrée of Leo, and his latitude is 72 degrées 40 minutes, and his declination is 73 degrees, so as he is distant from the North Pole, 17 degrées.

The longitude of the North guard is 109 degrées 30 minutes, so as his place is in the 20 degrée of Leo, and his latitude is 74 degrées 50 minutes, and his declination is 76 degrées, so as his distance from the North Pole is 14 degrées. Thus hauing shewed the greatnesse, the longitude, the true place, the latitude, and the declination aswell of the Lodstar, as of his two guards I thinke good now to set downe the chiefest uses that Sea-men haue of them.

CHAP.

Chap. XXXIX.

The uſes of the North ſtarre, and of his guards.



The firſt uſe is to know thereby the variation of the Mariners Compaſſe.

The ſecond is to know by his guards, when the North ſtar is above or beneath the Pole.

The third is to know by the North ſtar and his guards, with the helpe of an inſtrument called a Nocturalabe, the houre of the night.

The fourth is to know the elebation of the Pole, and you have to note that the North ſtarre and his guards are alwaies above our Horizon, and doe neuer goe downe in any place, where as the North Pole hath any elevation, be it neuer ſo little. But beſides theſe ſtarres there be alſo in this our latitude diuers other Images of ſtarres that are alwaies abe bour Horizon and doe neuer goe downe, as the Dragon, the great Beare, the Image of Cepheus, of Caſſiopeia, the Image of Auriga, having the Goat at his backe, which is a faire bright ſtarre of the firſt bigneſſe, and many others which I leave to name, becauſe I haue heretofore deſcribed them all at large in my Treatiſe of the Globes, by which ſtarres by reaſon that with us they neuer goe downe, the Latitude of any place, and alſo the houre of the night may be knowne ſo well as by the Loadſtarre.

But now as touching the uſes of the foreſaid ſtarres before mentioned, the firſt whereof ſhewing how to finde out by the Loadſtarre the variation of the Compaſſe, is taught before in the 25. Chapter, according to William Bourne his Rule ſet down in his Regiment, and as for the other three uſes they are plainly taught in the two Chapters next following.

Chap. XL.

To know by helpe of a little Table, made according to the Mariners Rule, touching the eight principall Rumbs, shewing how and when the Loadstar is either above or beneath the Pole, that you may know thereby the true altitude of the Pole, in taking the height of the Loadstarre with your Astrolabe or Crosse-staffe.

TO know this you must alwaies have true consideration of the two guards of the little Beare, for when those guards are full South well from the Loadstarre, then is the Loadstarre at his highest in the very Meridian, and therefore it is right above the Pole, and when those guards be full North all from the Loadstarre then the Loadstar is againe in the Meridian at his lowest, and thereby right under the Pole, and in both places his distance from the Pole, is but three degrees and a halfe, as Cognier saith: according to which account he setteth downe this Table following.

This Table is divided into two columnes, whereof that on the left hand containeth the eight principall Rumbs or windes, and that on the right hand containeth the degrees and minutes of distance of the Loadstar from the Pole, being either above or beneath the Pole, but that Table of Cognier being since lately corrected, and more truly calculated, is inserted instead of the other.

	The Rumbes or Windes		The degrees and minutes of the declination the Loadstarre from the Pole.		
If the guards be	West,	Then the Loadstar is	0	37	Above the Pole.
	South-west,		2	50	
	South,		3	24	
	South-east,		0	34	
	East,		0	37	Beneath the Pole.
	North-east,		2	50	
	North,		2	24	
	North-west		1	34	

This

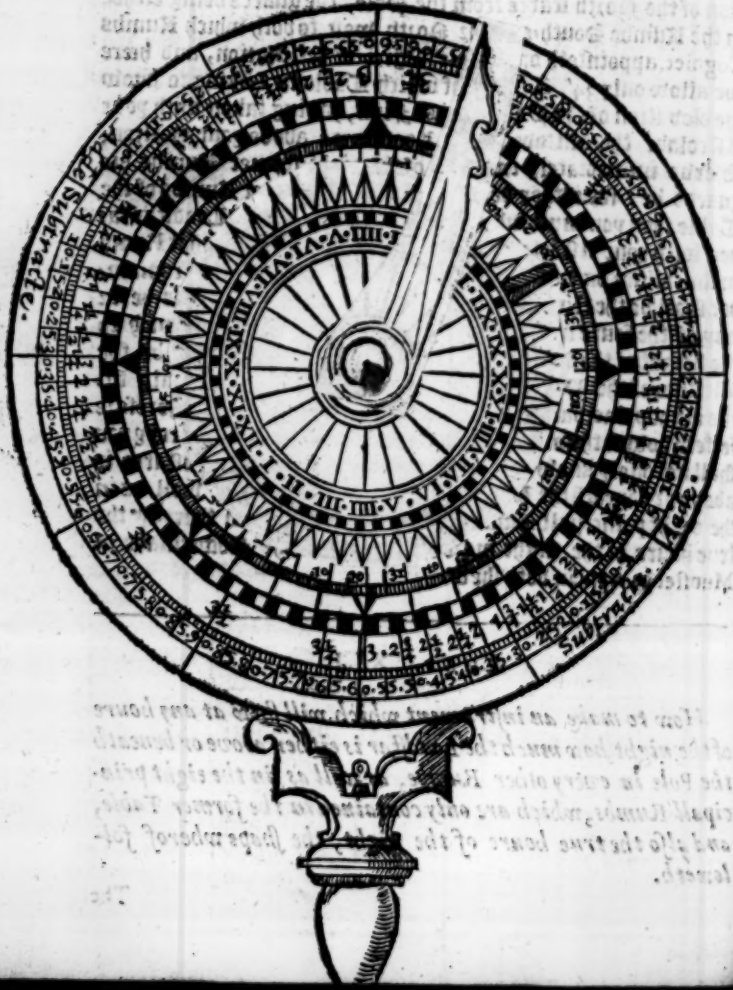
This Table differeth much from the Partners common rule ſet downe as well by Medina, as alſo by William Bourne, touching the guards, for they all appoint but halfe a degree of declination of the North ſtarre from the Pole, the guards being either in the Rumbe South-eaſt, or North-weſt, for both which Rumbs Cognier appointeth one whole degree of declination, and heere we allow only 34'. The uſe of which Table in ſeeking to know the elevation of the Pole is thus: First, having taken with your Aſtrolabe the altitude of the Loadſtarre above your Horizon, obſerve immediately in which of the eight former Rumbs his guards be: for if they be in any of the foure upper Rumbs of the Table then you muſt ſubtract from the height of the Loadſtar taken with your Aſtrolabe ſo much as is ſet downe for that Rumb in the collum on the right hand of the ſaid table, and the remainder ſhall be the true altitude of the Pole, but if the guards be in any of the foure nether Rumbs, then you muſt adde ſo much to the height of the Loadſtarre, and the ſumme thereof ſhall be the Altitude of the Pole. But becauſe this Table ſerveth only for the eight principall winds, and for no more, Cognier therefore ſetteth downe the making of a two-fold inſtrument, whereby you ſhall not onely know (as he ſaith) how much the Loadſtarre is above or beneath the Pole, in every other Rumbe as well as in the eight principall Rumbs but alſo you ſhall know thereby the true houre of the night more exactly, than the Nocturnlabe of Munſter or Appian doth ſhew.

Chap. XLI.

How to make an inſtrument which will ſhew at any houre of the night, how much the Loadſtar is either above or beneath the Pole in every other Rumbe, as well as in the eight principall Rumbs, which are only contained in the former Table, and alſo the true houre of the night, the ſhape wherof followeth.

The

The shape or figure of the Rectifier of the North Starre.





Ogniet calleth this instrument Rectificatorium Stellæ Polaris, that is to say, the Rectifier of the Northstar joyning thereunto a Nocturnlabe differing nothing at all from the Nocturnlabe of Munster and of others but only in placing the 21 of October instead of the 28 of the same month upon the line of North and South towards the handle of the instrument for such cause as is hereafter declared.

The making of the Rectifier of the Loadstarre, is thus: Upon a smooth peece of board of firme wood, or upon a peece of polished plate of brasse, or Latten, being six or seven inches broad, having a handle, as you see in the former figure, draw a circle divided into 4 quarters by helpe of two crosse Diameters cutting one another in the Centre with right Angles, the perpendicular whereof shall signifie the Meridian line, that is to say, the line of North and South, at whose upper end set North, and at the nether end South, and the other overthwart Diameter shall be the line of East and West, having East marked on the right hand, and West on the left hand, and in every quarter of the foresaid circle you may if you will place the like Rumbs that are in the Fly of the Mariners Compasse, as you may see done in the foresaid figure. Moreover you must divide the upper quarter on the left hand into three equall parts, and having taken two of those parts with your Compasses, measuring from the North point downe towards the West and there make a pricke, marking the same with a little black crosse, and from that crosse draw a right line that may passe thorow the Centre, into the circumference of the Circle, and there make another little blacke crosse, and this line shall divide the circle into two equall parts, which line if you crosse with another right line passing through the center, and making thereby right Angles, you shal divide the Circle into other foure quarters differing from the first foure quarters, though not in quantity, yet in place, of which foure last quarters you must divide that which is on the left hand into 90 equall degrees beginning your account at the little blacke Crosse on the left hand, and so proceed downewards toward the South point of the circle.

Now to know how much the Northstar in every Round mounteth or descendeth, and how to place the same upon the Instrument so as you may know how much to adde to the altitude of the Loadstarre, or to subtract from the same, you must use this Table following, which Table consisteth of two collumnes, whereof that on the left hand containeth the degrees and minutes of the declination of the Loadstar, proceeding from one quarter of a degree to an other, untill you come to 3 degrees and a halfe, which is (as Cognier saith) the greatest declination of the Loadstarre from the Pole: and the other collumne on the right hand containeth the degrees and minutes of a quarter or quadrant divided by divers and sundry proportions of numbers into 90 degrees, which proportionall degrees and minutes are to be reckoned in the first quadrant divided into 90 equall degrees, and next descending from the first crosse on the left hand thus.

This Table being Cogniers invention in those times were the best then knowne, but the truth being better explained you may in the making of the Instrument, use this Table or that formerly spoken of at your pleasure.

The degrees and minutes of the declination of the Loadstarre from the Pole.	The degrees and minutes of the Quadrant divided by divers portions of numbers into 90 degrees	
	Deg.	Min.
1/4	4	6
1/3	8	13
1/2	12	22
1 0	16	36
1 1/4	20	55
1 1/3	25	23
1 1/2	30	0
2 0	24	51
2 1/4	40	0
2 1/3	45	35
2 1/2	51	48
3 0	59	0
3 1/4	68	13
3 1/3	90	0

First beginning at the said crosse, and descending downeward, tell out 4 degrees and 6 minutes, and right against that set downe 1/4 then tell in the same quadrant from the said crosse 8 degrees and 13 minutes, and right against that set downe 1/3. and so proceed according as the Table directeth you, untill you come to 90, against which you must set downe 3 deg. and 1/2. And as this quarter is divided so you may deale with the other three quarters, and in each of the two quarters which are beneath the two crosses, forget not to write this word Subtract, and in each of the two quarters, above the two crosses write this word Adde, as you see in the former figure, then there shall want nothing but

but only a Ruler or Inder, which must be fastned to the Centre of the Instrument, so as it may be turned round about a pinne having a round hole in it, through which you may see the Loadstar, and also at the same instant by lifting up and downe the Inder you may see on the outside of the instrument the foreguard of the said Starre appearing even with the right edge of the Inder called Linea fiduciæ, or the ficuciall line drawne from the Centre of the instrument alongst the inner edge of the Inder, and so is the instrument for that purpose fully perfected. But if you would adde thereunto a Nocturnlabe, then you must draw upon the center thereof divers circles next to the space containing the winds, and the spaces betwixt those circles must be some wider, and some narrower: For, the first upper space must be narrow, containing the daies of every moneth, and the next space somewhat wider containing the number of those daies set downe in Arithmeticall figures, and the third space wider then that, containing the names of the moneths, then next to the lowest circle of the nethermost space, place a little rundle fastned to the instrument with the foresaid hollow pin, so as it may turne round about the same. And this Rundle must be divided into 24 houres, that is to say, 12 for the day, and 12 for the night, which Rundle would be made with teeth, whereof one must be longer then all his fellowes, signifying alwaies the 12 houres of the night, which is alwaies to be laid upon the day of the moneth wherein you seeke to know the houre of the night: And remember in distributing the daies of the moneth, that you alwaies set the 21 of October beneath towards the handle in the very line of North and South passing right through the middest of the handle, so shall the Instrument shew the houre of the night more truely then when the 28 day of October standeth beneath upon the line of South and North, as it doth in the common Nocturnlabes, the makers whereof had respect to the Pole it selfe which is invisible, and not to the North-starre which is apparant to the eye, by meanes whereof the guards of the Loadstarre sometime doe shew sooner or latter by seven degrees and 18 minutes if you count from the Pole, which is almost halfe an houre difference, and for that cause also Cognet maketh his account

in his foresaid Rectifier to beginne at the little blacke crosse, seven degrees more forward then it ought to do, if he should count from the Pole, and not from the North starre.

Chap. XLII.

How to know by the foresaid two-fold instrument as well the mounting and descending of the North starre, as the true houre of the night both at one instant, and also the elevation of the Pole.

FIrst then having laid and staied the great tooth of the moveable rundle, marked with 12 upon the day of the moneth wherein you seeke, and holding the instrument by the handle with your owne hand right before your face, leave not to put that hand forward from you, or to bring it backwards towards you, untill you may see with the one eye, winking with the other, the North starre through the hole of the pin, which is the Centre of the instrument: and so soone as you see the North starre, lift with your other hand the inder up and downe until you see also at that instant the North guard of the Loadstar on the outside of the instrument appearing even with the fiduciall line or inward edge of the said inder. Then staying the inder there looke upon what houre it falleth, for that shall be the houre of the night. And looke also at that instant upon what degree of distance it falleth in the outermost border of the instrument wherin those degrees are set downe together with these words add and substract. For from the point marked with a little blacke crosse nigh unto the North-west descending thorow the neither moyety or halfe deale of the Instrument until you come to the other black crosse, placed nigh unto the Southeast, the North starre is alwaies above the Pole so much as the inder sheweth, which you must alwaies substract from the height of the North starre to know the elevation of the Pole, having first taken with your Astrolabe the height of the North-starre. But if the inder doe fall upon any degree or part

of

of a degree in the vpper moity or halfe deale of the Instrument: then to know the elevation of the Pole, you must adde so much as the Inder sheweth vnto the altitude of the Loadstarre, as the words Adde and Subtract written in the outermost border of the Instrument doth plainely shew.

But now if you would know at any houre of the day or night, in what Rumbe the foresaid guards be, without seeing them, and also how much the Loadstarre is declined from the Pole, you neede doe no more but to lay the great tooth of the moueable Rumble vpon the day of the moneth, and then to bring the Inder vnto the houre which you require, and the said Inder will shew in the border of the Instrument in what Rumbs the guards be, and how much the Northstarre is aboue or beneath the Pole.

I haue found by often triall that this instrument will shew the true houre of the night, and also in what Rumbe the guards be, and thirdly, how much the North starre is at any time, either aboue or beneath the Pole, and by adding the degree of distance found in the limbe of the instrument, or by subtracting the same according to the Rule before given from that altitude of the North star, which I haue before taken with my Astrolabe, I haue found at all times the true elevation of the Pole, wheresoeuer I haue made triall thereof. But sith other Starres may perhaps appeare when the North starre with his guards shall be hidden, I would wish all carefull Mariners to acquaint themselues with as many bright starres as they can, and especially with those which do both rise and set, and also to learne by some Table the declination of every such starre, and whether it be Southernly or Northernly, for by taking the Meridian altitude of any such Starre and by adding to, or by taking from the altitude thereof, his declination, according as the same declination is either Northernly or Southernly (for if it be Northernly, then you must subtract his declination, and if it be Southernly, you must adde the same to the altitude of the starre) you shall finde thereby the altitude of the Equinoctiall, which being taken out of 90. the remainder will shew the elevation of the Pole. The meetest Starres for this purpose in these our North parts of the World, are these

Hircus the Goat, Canis minor the little Dog, Canis major the great Dogge, Dexter humerus Orionis, the right shoulder of Orion, Cingulum Orionis, the Girdle of Orion, Cor Leonis the Lyons heart, Bubulcus the Bareward, Spica Virginis, the wheat eare in the hand of Virgo, Aquila volans the flying Eagle, Caput Andromedæ, the head of Andromeda, Ras Argo, the head of Medusa, Oculus Tauri, the Bulleye, and divers others.

And in any case consider whether the declination of the Star, be greater or lesser then his Meridian altitude, for if his declination be greater then his Meridian altitude, as of those Stars which are nigh the Pole, then you must take his Meridian altitude with your Astrolabe at two severall times, that is to say, when he is at his highest in the Meridian, and also when he is at the lowest point of the same Meridian called the depression, and having added those Meridian altitudes together, take halfe thereof, and that halfe shalbe the elevation of the Pole, which way of finding out the elevation of the Pole is nothing meet for a Mariner that is under saile. But now to proceed according to Cogniet his direction in this matter, he saith, that if in sailing you approach so nigh unto the Equinoctial, as the elevation of the Pole is not above 17 degrees, then the guards are not so easily seene, wherefore it shall be needfull to take some other Starre whereby you may both know the houre of the night, and also how much the Loadstar is either above or beneath the Pole, and Cogniet thinketh none of the Starres more meet for that purpose then one of these two, that is, either the Starre called Caput Medusæ, that is, the head of Medusa called of the Arabians, Ras Algol, or else the Star called Hircus, that is, the Goat, both which are faire bright Starres and of the first bignesse: and the cause why he appointeth the head of Medusa, is, for that this Starre is directly oppolite to the former guard, in such sort as this Starre is alwaies above the Horizon, when both the guardes are under the Horizon. Wherefore having prepared your Instrument, that is to say, having laid the longest tooth of the moveable Alidade upon the day of the moneth wherein you seeke, and having found out thereby in such order as is before taught, the North-starre

and

and also the Starre called the head of Medusa, both at one instant marke where the Index falleth, and immediatly turne the Index from that point to the point opposite, abating twelve houres, and so the Index shall shew you three things at once: First, the Rumbe wherein the guards are at that present. Secondly, the houre of the night. And thirdly, how much the Northstar is above or beneath the Pole. But because this starre is not knowne perhaps to all Mariners, Cogniet would have you to take the other bright starre called Hircus, which (as he saith) goeth 9 houres and ½ before the guards, in such sort, as when the former guard is East, you shall finde this starre counting from the Northstarre to be Northwest, and almost 41 degrees distant from the Pole, with which starre if you worke, as you did before with the head of Medusa, saving that you shall not need to turne the Index unto the opposite point, but only to rebate from the point on which it falleth 9 houres and ½, you shall know all the three things last mentioned. And this Rule (as he saith) is so generall as you may have your desire by working in like manner with any other starre, that is to you certainly knowne, and is at that time above the Horizon.

Chap. XLIII.

What starres are observed by those that saile beyond the Equinoctiall line under the South Pole.

The ancient Astronomers, as Ptolomie, Timocharis, Hyparchus, and others, did never describe any Starre to be more nigh unto the South Pole, then that which is called Canopus, which is a faire bright Starre of the first bignesse, and according to the Tables of Copernicus, is distant from the South Pole 38 degrees and ½. But those that have sailed in the South Seas of latter dayes, have found out other Starres unknowne to the ancient Astronomers, which are much nearer unto the said Pole. For Albericus Vesputius writeth of

thre ſtarres, making together a Triangle Orthogonall: that is to ſay, having one right angle, now called the Southerne Triangle, the middle ſtarre whereof is diſtant from the South Pole, 9 degrees, ⅔.

There be alſo lately found out divers Images of other ſtars nigh unto the South Pole, as that which is called Noah his Dooue, or Pigeon, and another called poloplilax, made in the ſhape of a man, whoſe longitude and latitude hath not as yet bin rightly ſet downe by any that I haue read.

But the Sea-men of theſe preſent daies doe moſt commonly obſerue foure great ſtars, which according to the ſhape and forme thereof they call the Croſſe, inuiſioning the greateſt ſtarre of the foure to be the foot, and that which ſtandeth right over him to be the head of the Croſſe, and the other two to be two armes: and when they ſee, that the head doth directly anſwer the foot, then they ſay that the foot of the ſaid Croſſe is right above the Pole, and diſtant from the ſame 30 degrees. Therefore having taken the altitude or height of that ſtar above the Horizon with their Aſtrolabe they ſubtract 30 degrees from that altitude, & the remainder is the elevation of the Pole. Medina in his firſt booke and 11 chapter ſetteth downe the ſhape of the foreſaid Croſſe in this maner.



And he ſaith, that theſe Stars are neither any of thoſe ſtars that are appointed to the twelue Signes in the Zodiaque, nor yet any of the 36 Images or Conſtellations that be in heauen. Moreouer he ſaith, that in taking the altitude of the great Star called the foot, being in his right place, that is to ſay, when he is directly oppoſite to the head, and that you find his altitude to be 30 degrees, then you may aſſure your ſelfe that you are right upon the Equinoctiall. And if you find his altitude to be more then 30 degrees, then you are paſt the Equinoctiall towards the South Pole, but if you find it to be leſſe then 30 degrees then you are ſtill on the North ſide of the Equinoctiall.

Beſides

Beſides the ſtarres obove mentioned, our Mariners in theſe Northy parts of the world, are wont to obſerve divers other ſtars, to the number of 32, whoſe longitude and declination together with their bigneſſe, and alſo when they riſe and ſet, and when they are mounted to the Meridian, that is to ſay, are juſt South, is plainely ſet forth by Tables, collected of purpoſe out of the Aſtronomicall Tables by William Bourne, which Tables you ſhall finde in the 20 Chapter of his booke, called the Regiment of the Sea. And Robert Norman hath alſo ſet downe the like Tables, in his booke called the Attractive, as alſo in other bookes more lately calculated: and therefore I thinke it ſuperfluous to repeate the ſame againe here, and ſpecially ſith I have [illegible] vnto you all the Starres that be in the firmament, that were knowne to the ancient Aſtronomers, and have ſhewed you how to find out by the Globe their Longitudes, their Latitudes, their declinations, their greatneſſe and all other accidents belonging to the Starres in my Treatiſe of the Celeſtiall Globe, which I wrote of purpoſe to further young Sea-men.

The knowledge of the Starres ſerveth Sea-men chiefly to know thereby the latitude of any place, and alſo to know the houre of the night: and thirdly, to conjecture by their manner of riſing and ſetting, and other their aſpects, what weather is like to follow either foule or faire: the Rules whereof to teach truly, belongeth to Aſtronomers, yet many Sea-men by diligent obſervation doe attaine to right good judgement therin. Wherefore leaving to ſpeak any further of the Starres I will now briefly ſpeake of the Sunne and of his motions, of his riſing and ſetting in every Latitude, and of his declination from the Equinoctiall and of other his like apparances, I ſay here briefly, becauſe I have already ſpoken of him at large in the firſt part of my Sphеare, whereas I treat of the Zodiaque.

CHAP.

CHAP. XLIV.

Of the Sunne, and of his motions, and of the chiefest appearances belonging to him.

THe Sunne according to the moving of the first moveable, which is from East to West, maketh his daily revolation in 24 houres, as all other starres doe, but according to his owne motion which is from West to East, in going thorow the twelve Signes of the Zodiaque, he spendeth a whole yeare, for his daily moving upon his owne Centre, called the Excentrick, because it is out of the Centre of the worlde, is little more then 59 minutes, 8 seconds, making thereby the whole yeare to consist of 365 daies, five houres, 49 minutes, 8 seconds, 19 thirds, 37 fourths, 24 fifths: and this is called of Copernicus, the equall tropicall yeare, which taketh his beginning from the first point of Aries, otherwise called the Vernall Equinox, into which point the Sunne entreth not every yeare at one selfe day of the moneth, for sometime he entreth into that point the tenth day, and sometime the eleventh day of March, which day of his entring is always truely set down in every Ephemerides, and because the beginning of the tropicall yeare is so uncertaine, the Astronomers doe make their yeare called the Sydereall yeare, to begin at the former starre of the Rammes horne, and thereby, do make the yeare to consist of 365 dayes, 6 houres, 9 minutes and 39 seconds, according to which yeare they always trulie or nigh to equality, accord the equall as the unequall tropicall yeares, of both which I have spoken in the first part of my Spheare, the 38 and 39 Chapters.

Moreover, the Sunne hath three motions, that is slow, swift, and meane. His slow motion is when he is in the point called Auge or Apogeon, which is a point imagined to be nigh unto the outermost edge of the Circle, which carrieth the body of the Sun called Deferens Solis, and is furthest distant from the Centre of the worlde, which point in these our daies is in the 9 degree of Cancer

Cancer, or thereabouts. And being in that point, he goeth little more then 57 minutes in 24 houres. Againe, his swift motion is when he is in the opposite point to the Auge, called Perigion, which point in these dayes is in the 9 degree of Capricorne, and being in this point, hee goeth one whole degree and almost two minutes in 24 houres, which is almost five minutes more then he maketh in his slow motion. His meane motion is when he is in the midst betwixt the two foresaid points, whereas in foure and twenty houres he goeth one whole degree, and somewhat more than two minutes. And these three sundry motions doe cause the Equinoctiall point not to be of Equall distance. For the Sun spendeth 7 dates and somewhat more, in going from the Equinore of March, to the Equinore of September, then he doth in going from the Equinore of September to the Equinore of March. For if in this present yeare 1612 which is leape yeare, you count the dates from the Vernall Equinore, which is the eleventh of March, unto the Autumne Equinor, which is the 13 of September, you shall find the number of the dates to bee 186, and the other number from the 13 of September to the eleventh of March, to be but 180, which is lesse then the first number by 6 dates, and if it were not leape yeare, the difference would be seven dates, because that February in the leape yeare hath 29 dates.

It is necessary that Sea-men have some understanding of the three foresaid motions, to the intent that they may the better know the true place of the Sunne, and thereby his true Declination. And note that no calculation of his Declination can continue without errour above 24 yeares. For as often as the leape yeare commeth about, which is every foure yeares, the Sunne is upon the Equinoctiall sooner by halfe an houre. But as for the true place of the Sunne, and especially every day at Noontide, the Ephemerides doth most truly shew, and having his place, you shall easily find his declination by this Table following, which will serve for these twenty yeares and more, the like whereof, together with the use of the same is set downe in the first part of my Sphere the 13 Chapter.

A Table shewing the declination of the Sunne euery day throughout the yeere.

Degrees of the Signes.	♈ D. M. S.	♉ D. M. S.	♊ D. M. S.	Degrees of the Signes.
1	0 23 57	11 51 48	20 24 57	29
2	0 47 53	12 12 41	20 38 59	28
3	1 11 48	12 33 21	20 49 9	27
4	1 35 44	12 53 50	21 0 15	26
5	1 59 37	13 13 5	21 12 28	25
6	2 23 28	13 34 8	21 23 8	24
7	2 47 18	13 53 57	21 43 23	23
8	3 11 4	14 13 32	21 43 15	22
9	3 34 48	14 32 53	21 52 43	21
10	3 58 28	14 51 59	22 1 45	20
11	4 22 55	15 10 51	22 10 20	19
12	4 45 37	15 29 27	22 18 35	18
13	5 9 5	15 47 47	22 26 22	17
14	5 32 29	16 5 52	22 33 44	16
15	5 55 47	16 23 38	22 40 40	15
16	6 18 59	16 41 9	22 47 10	14
17	6 42 6	16 58 22	22 53 14	13
18	7 5 6	17 15 18	22 58 52	12
19	7 28 0	17 31 56	23 4 3	11
20	7 50 47	17 48 15	23 8 48	10
21	8 13 36	18 4 16	23 13 6	9
22	8 35 38	18 19 48	23 16 57	8
23	8 58 21	18 35 20	23 20 21	7
24	9 20 36	18 50 22	23 23 18	6
25	9 42 42	19 5 5	23 25 48	5
26	10 4 38	19 19 26	23 27 51	4
27	10 26 25	19 33 27	23 29 27	3
28	10 48 2	19 47 7	23 30 35	2
29	11 9 28	19 59 59	23 31 16	1
30	11 30 44	20 13 22	23 31 30	0
D.	D. M. S.	D. M. S.	D. M. S.	D.

THe vſe of this Table is thus: If the Sunne be in any of the ſignes ſet downe in the front of the Table, then ſéeke his degrée (firſt found by the Ephemerides) in the left collumne, the degrées whereof doe deſcend from one to 30: and the ſquare angle anſwerable to that ſigne and degrée will ſhew his declination. But if the Sunne be in any of the ſignes that are in the foot of the Table then ſéeke his degrée in the collumne at the right hand, the degrées whereof do aſcend, and the ſquare angle anſwerable to that ſigne, and degrée, will ſhew his declination.

There be other things alſo méet for Sea-men to know touching the Sunne, as theſe: Firſt, to know the foure ſeaſons of the yeare: ſecondly, to know by his declination, the length of both the day and the night in every latitude, and how it doth encreaſe and decreaſe. Item, to know in what Rumbe or wind, and at what houre he riſeth and ſetteth, and alſo his Meridian altitude that is, when he is right South every day, to find out by the help of that, and by knowing his declination, the true Latitude of any place, and by his ſhadow to know the houre of the day. which are two chiefe points that the Mariner hath moſt néed to know. Of all which things I mind héere to treat both plainely and briefly.

CHAP. XLVI.

Of the foure ſeaſons of the yeare, that is, Spring time, Summer, fall of the leaſe, called otherwiſe Autumne, and winter.

IN this our Clime the ſpring is ſaid to begin when the ſun entreth into the firſt point of Aries, which is about the 11 of March, and continueth unto the laſt point of Gemini, which time is ſaid to bée hot & moiſt, and therefore is likened to childhood: And ſummer beginneth when the ſun entreth into the firſt point of Cancer, which is about the 12 or 13 of June, and

and endeth when he is in the laſt degree of Virgo: and this time is ſaid to be hot and drie, and therefore is likened to Adoleſcency: Then Autumne or fall of the leafe beginneth when the Sunne entreth into the firſt point of Libra, which is about the 13 or 14 of September, and endeth when the Sun is in the laſt degree of Sagittarius: and this time is ſaid to be cold and dry, and therefore is likened to Manhood: Finally, Winter beginneth when the Sunne entreth into the firſt point of Capricorne, and endeth when he is in the laſt degree of Piſces: and this time is ſaid to be cold and moiſt, and therefore is likened to old age: notwithſtanding, Galen in his firſt booke de Elementis ſaith, that the ſpring is temperately hot and moiſt, and therefore a moſt wholſome time: And Summer is more hot then cold, and more drie then moiſt, and therefore is ſaid to be hot and drie: and Autumne is alſo ſaid to be drie, becauſe it is more drie then moiſt, and yet neither hot nor cold, but unequally mixt, and thereby infective, and cauſing ſickneſſe. And Winter is ſaid to be cold and moiſt, not becauſe it is colder, or moiſter, then any other ſeaſon, but becauſe that in Winter moiſture exceedeth drineſſe, and coldneſſe exceedeth heat. But you have to underſtand, that theſe foure ſeaſons have not like qualities in all the five Zones. For in the burnt Zone, and ſpecially to thoſe that dwell right under the Equinoctiall, the Sunne being in Aries or Libra, cauſeth greateſt heat, and therby two Summers, becauſe he is then right over their heads, and being in either of the Solſtices, that is in the beginning of Cancer or Capricorne, he cauſeth two Winters, becauſe he is then furtheſt from them, as I have declared unto you in the ſecond part of my Treatiſe of the Spheare, the 20 Chapter, where as I treat of the ſeaſons and ſhadowes incident to divers Climes and Parallels, whereunto I referre you, and ſo I end with this matter.

CHAP.

Chap. XLVII.

How to know when the Sun riſeth and ſetteth in every latitude, and thereby the length of the day and night, and alſo in what Rumb or wind he riſeth and ſetteth, and how much he declineth every day from the Equinoctiall either Northward or Southward. Alſo how to know the elevation of the Pole, otherwiſe called the Latitude of any place, by knowing the meridian altitude of the Sun, and his declination.

The moſt part of all theſe things hath beene taught before in my Spheare, in my Treatiſe of the Globes, and alſo in my Treatiſe of the Aſtrolabes. And in the firſt two Treatiſes I ſhew alſo how to find out the longitude of any place, and therefore needeth not here to be rehearſed: but if you would know how to handle the declination of the Sunne, being upon the Sea, then read the 7, 8, 9, and 10 Chapters of William Bourne his booke, called the Regiment of the Sea, and you ſhall be fully inſtructed therein: The whole effect of all which Chapters, Robert Norman ſetteth downe in few words in his new attractive, in this manner as followeth.

Firſt learne whether the Sunne have South declination or North declination, which you ſhall know by his being in any of the Northerne or Southerne ſignes: Then marke what ſhadow he caſteth, and whether it ſtreeketh towards the Pole whereunto he is neareſt, or to the contrary: For if the Sunne caſteth his ſhadow the ſame way that he is from the Equinoctiall, he ſhalbe betwixt you and the Equinoctiall, and then having taken his Meridian altitude, ſubtract the ſame from 90, and adde unto the remainder the Suns declination for that day, and the ſum thereof ſhall be the elevation of the Pole, or the diſtance of your Zenith from the Equinoctiall, called the latitude, which is alwaies equall to the elevation of the Pole: but if the Sunne caſteth his ſhadow to the contrary ſide of the Equinoctiall, that is to ſay, being in his North declination, he caſteth his ſhadow Southward,

or

or being in his South declination casteth his shadow Northward, then either the Equinoctiall shall be betwixt you and the Sun, or you in the Equinoctiall. or else, you shall be betwixt the Equinoctiall and the Sun, which you shall know thus: Adde the declination of the Sunne for that day, wherein you seeke unto his Meridian altitude, and if the summe of the addition be lesser then 90 degrees, then so much as it wanteth of 90 degrees shall you be distant from the Equinoctiall on that side on which the shadow streeheth: but if it amounteth just to 90 degrees, then you shall be right under the Equinoctiall. Againe, if it be more then 90 degrees, then so much as is the overplus, so much shall you be from the Equinoctiall towards the Sunne, at which time you shall be also betwixt the Equinoctiall and the Sun. And if you find the Meridian altitude of the Sunne to be even with your Zenith, then looke what declination the Sunne hath at that instant and so much shall you be from the Equinoctiall on that side wherein the Sunne is, but if the Sunne hath no declination, then shall you be right under the Equinoctiall line.

Chap. XLVIII.

Of the shadow of the Sunne, and how to know thereby the houre of the day in any latitude by help of an universall Diall.

My former order now requireth that I should speake somewhat of the shadow of the Sunne, and of the diversity thereof, according to the Clime or Parallell under which you saile. But for so much as I have shewed you in the second part of my Spheare from the 20 to the 27 chapter of the same, what divers shadowes the sun casteth in divers Climes and Parallels, and also have shewed what Umbra recta and Umbra versa is in the 40 Chapter of my Treatise, of the Astrolabes, I minde not here therefore to make a new recitall thereof, but onely to shew how you shall finde by his shadow the true houre of the day in every Latitude by a generall Dyall, made to serve in all Latitudes, of which Dyals though I have seene divers and of divers shapes,

yet

yet none liketh me better then that which William Bourne ſetteth downe in his Regiment the 21 Chapter, and calleth it the Equinoctiall Dyall, which ſerveth not only to know the houre of the day by the ſhadow of the Sunne, but alſo the houre of the night by the ſhadow of the Moone when ſhe ſhineth cleare, which Dyall being of ſmall charge, I would wiſh all Mariners to have. The making and uſe whereof is ſo plainely ſet downe by himſelfe in the foreſaid Chapter, as I thinke it ſuperfluous to ſet it downe againe here. And thus ending with the Sunne, I will now turne my pen to the Moone.

CHAP. XLIX.

Of the Moone and of all her divers motions.

THe Moone is a round, thick, and dark body, having no light of her ſelfe, but only ſuch as ſhee receiveth from the Sun, and ſhe maketh her daily motion from Eaſt to Weſt, as all other ſtarres doe in 24 houres, according to the moving of the Primum mobile: But according to her own motion, which is from Weſt to Eaſt, ſhee goeth but 13 degrees, 12 minutes in the ſpace of 24 houres, and that is according to her meane motion. And ſhe paſſeth thorow the 12 ſignes of the Zodiaque in 27 daies and eight houres: during which time the Sunne by his naturall motion which is alſo from Weſt to Eaſt, is removed from the place of conjunction almoſt 27 degrees, ſo as the Moone not finding out the Sun there, ſpendeth two daies, 4 houres, and 44 minutes more in overtaking him, which being added to 27 daies and 8 houres, doe make in all 29 daies, 12 houres, and 44 minutes. Notwithſtanding by reaſon that the Moone hath as well as the Sun three motions, that is, ſwift, meane, and ſlow, ſhee may change ſometime ſooner and ſometimes later then in 29 daies, twelve houres, 44 minutes, and yet one change counted with an other ſhal make up the ſelfe ſame ſumme. And note that this her three-

ſolo motion dependeth upon two points, the one called the Auge, and the other the point oppoſite to the Auge.

The point Auge of the Moone is when ſhee is furtheſt diſtant from the earth, and the point oppoſite to that is, when ſhee is nigheſt to the earth, for when ſhe is in the point Auge, ſhe goeth little more then twelve degrees in 24 houres: but when ſhe is in the oppoſite point, ſhee goeth almoſt 15 degrees in 24 houres: And in her meane motion, which is in the middeſt betwixt the two foreſaid points, ſhee goeth 13 degrees, and 12 minutes in 24 houres.

Now becauſe the Mariners doe account the moving of the Moone by the points of their Compaſſe, they may thereby underſtand that ſhe goeth not alwaies in 24 houres one point and three minutes as they reckon, but ſometime more and ſometime leſſe: For when ſhe is in her ſlow motion, ſhe goeth little more then 12 degrees in 24 houres, in which time the Sunne goeth one degree, ſo as the Moone is diſtant from the Sun but 11 degrees, which is but 44 minutes of an houre, which wanteth 4 minutes of a whole point, whereto is attributed 48' as hath bin ſaid before: and in her ſwift motion ſhe goeth 15 degrees, in which time the Sunne goeth one degree, ſo as ſhe is diſtant from the Sun 14 degrees, which is more then a point and three minutes of the Compaſſe. And you have to note, that the point Auge of the Moone is moveable, and paſſeth thorow the Zodiaque in the ſpace of 19 yeares, and thereby ſometime cauſeth the full of the moone to happen ſooner or later.

Chap. L.

How to know in what ſigne the point Auge of the Moone is in any yeare.

If you would know in what ſigne the Auge of the Moone is in any yeare, then you muſt conſider the Prime or Golden number of that yeare, for when the Prime or Golden number is one, then her Auge is in Aries, and if the Moone be alſo then in Aries, ſhe

is

is in her slow motion: and being in the point opposite, which is ♎, shee is in her swift motion. And with this Auge of the Moone goeth through the 12 signes in 19 yeares, as hath beene said, it must needs fall out that in 9 yeares and a halfe, her Auge commeth to be in Libra: And then the Moone being there shee is in her slow motion: And being in the point opposite, which is Aries, shee is in her swift motion. Againe, when the Prime is 5, then her point Auge is in Cancer: and the Moone being there she is in her slow motion, and when shee commeth to be in the point opposite, which is Capricorne, shee is in her swift motion: And when the Prime is 14 or 15, then her point Auge is in Capricorne, where if the Moone be also, then shee is in her slow motion: and being in the point opposite, which is Cancer, shee is in her swift motion. And note when the Moone is in her swift motion, shee maketh her change or full, or any other aspect the sooner: And contrariwise when shee is in her slow motion, shee maketh her change, or full, or any other aspect the later. Moreover you shall see her at the time of her change, either sooner or later, according to the time of ỹ yeare, for from January to June you shall see her within 24 houres after her change, because shee hath, during those moneths, North declination from the Sunne, and maketh a greater arch then the Sunne doth. But from July to December you shall not see the Moone scant three daies after the change. But you may see her within 24 houres before her change, because that during those moneths shee hath South declination from the Sunne: And note that when the Moone is three daies 7 18 houres, which is the halfe quarter of the Moone, the Sea-men doe call that time the Prime day, because the Moone is then 4 points to the Eastward of the Sunne, which is three houres, for to every point is attributed three quarters of an houre, as hath bin said before. Moreover, it is necessary for Sea-men to know when the Moone riseth and setteth, and in what part of the Horizon in every latitude: and how long shee shineth, and when shee is full South, and also what latitude shee hath, and whether it be South or North every day and houre throughout the yeare. All which things are most easie to be found by the Globe, and by helpe of the Ephemerides, in such sort as is

before taught in my Treatise of the Globes, and also by helpe of M. Blagraue his Astrolabe, her true place in the Zodiaque being first knowne by the Ephemerides. It is next also to know when she is in conjunction with the Sun, or at the full, and the rest of her quarters, which is easily knowne by the Ephemerides.

Chap. LI.

When the Moone is said to be in conjunction with the Sun, or to be at the full, and what her greatest latitude is, as well from the Ecliptique line, as from the Equinoctiall.

SHe is said to be in conjunction with the Sunne when the Sun and she be both in one selfe signe and like degree: but when she is at the full, then she is opposite to the Sun, and distant from him six signes, which is the one halfe of the Zodiaque, containing 180 degrees: and in every quarter she is distant from the Sunne three signes, which is 90 degrees: Moreouer, the Moone is said to haue Latitude both Northerne and Southerne from the Ecliptique line, which line the different of the moone crosseth in two points, and thereby maketh two intersections, whereof the one tending towards the North is called the head of the Dragon, and the other intersection towards the South is called the taile of the Dragon, so as when the moone is passed 90 degrees from the Dragons head towards the North, then her Latitude is five degrees Northward: And when she is distant 90 degrees from the taile of the Dragon towards the South, then her Latitude is also five degrees Southward, which is the greatest Latitude that she hath on either side of the Ecliptique line, whereof I haue written more at large in the first part of my Spheare the 25 Chapter, in which you shall find a figure representing the said Dragon both head and taile: but her Latitude is to be considered in two respects, that is not only from the Ecliptique line, but also from the Equinoctiall, for from the Ecliptique line her greatest Latitude is but 5 degrees on either side

ſide of the Ecliptique, as hath beene ſaid before. But from the Equinoctiall her greateſt Latitude is 28 degrées and a halfe, on either ſide of the Equinoctiall, which in mine opinion might be more rightly called her greateſt declination, which exceedeth by 5 degrées, the declination of the Sun, for that is but 23 degrées and a halfe, or rather according to Tycho Brahe 31', and 30", on either ſide of the Equinoctiall. But this great Latitude of the Moone is only to be underſtood when the Prime is one, and that her Auge is in Aries: For when the Prime is betwixt 9 or 10 yéeres or more, the Moone declineth not from the Equinoctiall on either ſide above 18 degrées and a halfe, at the moſt.

CHAP. LII.

How to know in what part of the Zodiaque the head of the Dragon is every yeere.

IF you would know in what part of the Zodiaque the head of the Dragon is, then you muſt conſider the Prime, for when the Prime is one, then the Dragons head is in the firſt point of Aries, even as the point Auge is. And in 19 yéeres it paſſeth through the twelve Signes aſwell as the point Auge of the Moone, but with contrary courſe, for the point Auge of the Moone, moveth according to the ſucceſſion of the Signes, that is, from Aries to Taurus, Gemini, and ſo forth: but the head of the Dragon hath a contrary motion, that is, from Aries to Piſces, and ſo into Aquarius, and ſo forth, as in nine yeeres and a halfe, it meeteth juſt with the point Auge of the Moone in the Signe Libra. Thus you ſee that by knowing the Prime, you learne alſo to know in what Signe the Auge of the Moone, and alſo the Dragons head is, and what Latitude the Moone hath, aſwell from the Ecliptique line as from the Equinoctiall. But one of the chiefeſt points to be had by the Moone, is to know thereby the Tides, that is, when the Sea floweth and ebbeth in any place: whereof we come now to ſpeake.

Cahp. LIII.

How to know the Tides in any place by the Moone.

BEfore that you enter into any Haven or River, it is necessary to know the true Tides of that place, which Tides are subject to the motion of the Moone, for she causeth at one place or other alwayes in one certaine Rumbe, full Sea. As for example, it is alwayes ful Sea at Antwerp, when the Moone is either right East or West: and it is ebbe or low water there when she is North or South, and because the Moone doth passe thorow all the Rumbs of the Mariners Compasse in 24 houres, they allow to every Rumbe ½ of an houre, which is 45', and that being multiplyed by 32, do make just 24 houres, wherefore if the two Rumbs, North and South, do yeld each of them 12 houres, then the first Rumbe must neds yeld ½ of an houre: the second, one houre and ½: the third, two houres and ½: and so forth, of the rest: For by adding to every Rumbe ½, you shal finde that the East and West do yeld alwayes 6 houres: but then you must note, that according to the age of the Moone, the Tides do fall every day later and later, wherefore to know the true time of the Tide in any place, you must first learne by some Rutter or by the relation of others that can tel in what Rumbe the Moone causeth full Sea in that place, and then at what houre it is full Sea, the Moone being either in the change or at the full, which you shall know by allowing to every Rumbe ½ of an houre, in such manner as is before set downe. But if you would know at what houre it is full Sea in that place every day, then you must first understand that the Moone in 30 dayes, slacketh 24 houres, which amounteth to ½ of an houre, which is 48 minutes for every day, for so much she declineth every day from the Sunne, then looke how many dayes the Moone is old, and having multiplyed the same by ½, that is to say, by 48 minutes, adde the product thereof to those houres, at which it is full Sea, and you shall have the true time of ful Sea every day; As for example, suppose that it was full Sea at the last new Moone at some place here in

England

England at three of the clock in the afternoone, and now I would know at what a clock it shal be ful Sea five dayes after the new Moone. Now if you multiply 5, being the age of the Moone, by 48 minutes, and adde to the product thereof three houres, which was the time of the last change, the full Sea shall be at that place at seaven of the clock. But if the summe of such addition be above 12 houres, then you must cast away the 12, and the remainder shall shew you the true houre of full Sea.

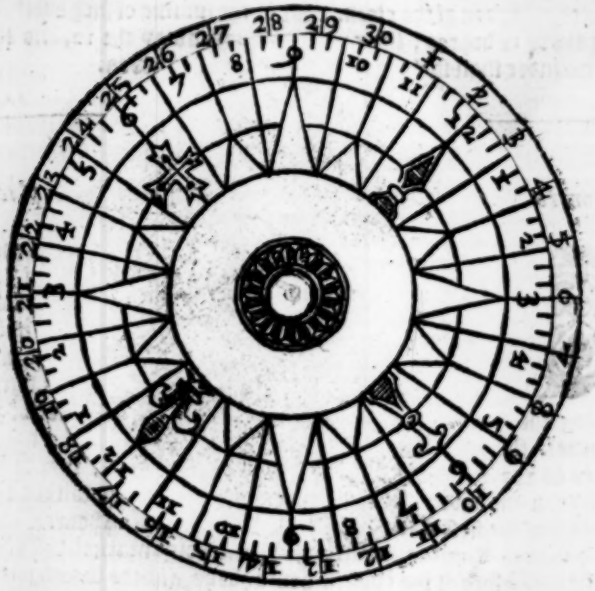
CHAP. LIIII.

How to know by help of an Instrument the Tides at any place.

THere is also an easier way to know the Tydes every day in any place, by the help of an Instrument, set down by Cogniet, whereof both the making and use here followeth. First upon some board wel plained and made smooth, draw a circle, and divide the same into 30 parts, signifying the dayes or age of the Moone, setting the number of 30 above in the top of the instrument, and place all the other numbers as 1, 2, 3, and so forth towards your right hand, that done, make a movable rondle which may turne about within the verdge of the first Circle, and divide that into 24 houres, and also into 32 Rumbes, setting the North point marked with the Flower-delice at the twelfth houre above, and the South point at the twelfth houre beneath, and the East point at the sixth houre on your right hand, and the West point at the sixth houre on your left hand, and so shall your Instrument be perfect, the use whereof is thus:

First, you must know what Rumbe or point of the Compasse being upon the Moone in that place which you seeke maketh a full Sea, & also the age of the Moon by some Almanack, or some other rule before taught, then having these two things, turne the inward rondle of the houres & Rumbs, untill the foresaid known Rumbe doth justly answer to the 30 day of the great rondle, and

there laying it firme with your finger, seeke in the outermost border of the greater rondle the age of the Moone, and that will shew you in the rondle of houres, the very houre of full Sea that day in that place.



But one chiefe thing touching the knowing of the Tides, is to be noted as Bourne saith, which is, that the Sea will flow more by one point of the Compasse in the spring-tides, than in any of the quarters of the Moone, called Nep-tides, in every River, that hath any indraft, and is of some reasonable distance from the Sea: as for example, it floweth at Graves-end at the change or full of the Moone, when she is South South-west: but in any of her quarters it scant floweth when she is South and by West, and this Rule, as he saith, is generall for ever.

CHAP.

Chap. LV.

How a generall Rutter ſhewing the Tydes in all places ſhould be made.

William Bourne doth ſet down what Moone doth make a full Sea, as wel here in the moſt parts of our Engliſh coaſts as in ſome other parts of France and Spaine, and ſo do many others, whoſe Tables touching the Tides are called Rutters, whereof ſome are truly ſet downe and ſome are falſe: but ſith ſuch Rutters do ſerve but for a few particular places, I would wiſh that ſome learned Pilot that hath ſayled many, and ſundry long voyages, to make a generall Rutter that might ſerve for all places if it were poſſible, or at the leaſt for ſo many places as are knowne in theſe dayes: And I would wiſh ſuch a generall Rutter to be made in manner of an Alphabet: And that every place might have his true Longitude and Latitude added thereunto, to the intent that every place might be the more eaſily found out in any Map, or Card that is graduated with degrees of Longitude and Latitude: And then to ſhew what Moone doth make a full Sea in every place, which thing whoſoever would performe, he ſhould in my opinion deſerve great commendation. And thus I end this Treatiſe praying all the learned Seamen not to bee offended or grieved with me for that I do make yong Gentlemen, our owne Countrymen, partakers of their moſt worthy knowledge, whereof the ignorant are not able to judge, nor to yeeld them that prayſe which they deſerve: yea rather I hope they will helpe to perfect whatſoever I have herein left unperfected, to make the young Gentlemen the more ſkilful, and thereby the more ſerviceable to their Countrie, any in ſo doing they ſhall procure to themſelves great good will and infinite thankes.

A

BRIEFE DESCRIPTION

of universall MAPS and CARDS,
and of their use.

And also the use of *Ptolomey* his Tables,
together with the true order of making
the sayd Tables.

And of all other *Maps* and *Cards*, aswell universall as particular, and that according to the doctrine of the best Geographers that be, or have been in these later daies.



LONDON,
Printed by *Richard Bishop*. 1636.

Certaine Termes of Gosmographie, briefly expounded for those that are not learned in that Science, to the intent they may the better understand this Treatise.

THe Axeltree of the world is a right line, imagined to passe thorow the Centre or midst of the earth, from the one end of heaven to the other: the upper end of which Axeltree is called the Pole Artick, that is to say, the North Pole: and the nether end, the Pole Antartick, that is, the South Pole: upon which two Poles, otherwise called the hookes or hengils of the World, the heavens doe turne round about the earth, and this Axeltree signifieth also the first Meridian. Moreover the Gosmographers doe divide the world into divers parts by certaine Circles, whereof some are called greater, and some lesser.

The Axeltree of the World.

The two Poles.

The greater are those which doe divide the world into two equall parts, whereof there be five: that is, the Equinoctiall, the Zodiaque, the Meridian, the Horizon, and the two Colures.

The greater Circles.

The Equinoctiall is a great Circle, girting the world in the very midst betwixt the two Poles, by reason whereof there are two Latitudes, the one Northerne, and the other Southerne.

The Equinoctiall.

The Northerne Latitude is that space which is contained betwixt the Equinoctiall and the North Pole.

The north Latitude.

The Southerne Latitude is that space which is contained betwixt the Equinoctiall and the South Pole, and either of these two spaces containeth in breadth 90 degrées.

The south Latitude.

A degrée is one part of a Circle, being divided into 360 parts called degrées.

Againe, the circuit of the Equinoctiall, containing 360 degrées is the very Longitude of the earth: the first degrée of which Longitude beginneth at the first Meridian placed in the West, and so proceedeth Eastward unto the 180 degrée of the Equinoctiall, and from thence returneth by the West untill you come againe

gaine to the 360 degree, which is the last degree of Longitude. And note by the way that every degree of the Equinoctiall containeth 60 English miles, so as the Longitude of the whole earth is 21600 miles.

The Zodiaque is a great, broad, and slope, or shoring Circle, carrying the 12 signes: in the midst whereof is a line called the Ecliptique line from which the Sunne never swerveth.

The Meridian is a great Circle, passing over our heads, in what part of the World soever we be, and also through both the Poles: which line when the Sun toucheth it above the Horizon, it is noonetide or midday to those that dwell under the same.

The Horizon is a great Circle, dividing the upper halfe of the world which we see, from the nether halfe which we see not: in the very middest or Centre of which Circle, if in a plaine field you looke round about you, you shall alwaies find your selfe to be.

Now as touching the two Colures, because they differ not in effect, though in name, from two Meridians, I leave to speake of them, aswell for that I have spoken of the at large in my Sphere, as also, for that they are not mentioned in this Treatise.

The lesser Circles. Of the lesser Circles, there be foure: that is, the two Polar Circles, and the two Tropickes. Of the two Polar Circles, the one environeth the North Pole, and therefore is called the Circle Articke, and the other environeth the South Pole, and is called the Circle Antarticke, because it is opposite to the other.

Againe of the two Tropickes, the one is placed betwixt the Equinoctiall and the Circle Articke, and is called the Tropicke of Cancer, and the other is placed betwixt the Equinoctiall and the Circle Antarticke, and is called the Tropicke of Capricorne: and each of these Tropickes is distant from the Equinoctiall 23 degrees and a halfe, which is the greatest declination of the Sun from the Equinoctiall, for he never mounteth higher then the Tropicke of Cancer, nor descendeth lower then the Tropicke of Capricorne, and these two Circles are Parallels to the Equinoctiall.

Parallells are two lines or Circles equally distant in all places one from another. And by these foure lesser Circles the earth is divided into five Zones or broad spaces, whereof there be

two

two cold, two temperate, and one hot, described both in my Spheare, and also in this Treatise.

A Parallell of the longest day, is a space of the Earth, wherin the day increaseth by one quarter of an houre, proceeding from the Equinoctiall towards any of the Poles.

A Clime is a space of the earth, containing two such Parallels wherein the day increaseth by halfe an houre, of which Climes according to the old writers, there be seven declared at the full in my Spheare, and also somewhat touched in this Treatise.

A briefe description of universall Maps and Cards, and of their use, and also of the use of Ptolomie *his Tables.*

THis word Mappa in Latine signifieth a Table-cloath of lynnen to cover a board: of the shape and likenes whereof, universall Tables containing the description of the earth, are commonly called Maps. And first you have to understand, that every such Map is chiefly traced with two sorts of lines or circles, that is Meridians and Parallels. The Meridians are either right or circular lines passing through both the Poles of the world, and are imagined to be drawn right up and down from the head to the foot of the Map, and are called Meridians, of this Latine word Meridie, which is as much to say as midday or noonetide. Because that when the Sunne commeth to touch any of those lines, it is midday to those that dwell right under the same. Againe, Parallels are either right or circular lines imagined to be equally distant one from another, which doe crosse the foresaid Meridians with right Angles. Now in the very midst of the Map is most commonly drawne from head to foote a right line, which signifieth not only the first Meridian, but also the Axeltree of the world, the upper end of which line called the Pole Artique, that is to say, the North Pole, and the nether end, the Pole Antarticke, that is the South Pole, and this line is crossed in the very midst betwixt the two Poles, with another great Circle or right line called the Equinoctiall, because that when the Sunne commeth

commeth to touch this line or Circle, the day and night is equall throughout the world, the one halfe of which line toward the right hand ſheweth the Eaſt part: and the other halfe towards the left hand ſheweth the Weſt part of the world: ſo as theſe two lines, the firſt Meridian, and the Equinoctiall, doe point out the foure quarters of the World, North, South, Eaſt, and Weſt, from whence the foure principall windes doe blow, betwixt which windes are ſet downe in moſt Maps, toge ther with their Latine or Italian names in the outermoſt skirt or border thereof, eight other winds, ſo as in all there be 12 windes, whereby the ancient Grækes, and Romanes were wont to saile. The names whereof both Græke, Latine, and Engliſh, are heretofore ſet downe in the latter end of my Spheare.

But now to returne to our firſt two lines, that is, the firſt Meridian & the Equinoctiall, you have to note that both theſe lines, or Circles are divided each of them into 360 degræs, ſo as every quarter of them containeth 90 degræs. And in the Equinoctiall are ſet downe the degræs of Longitude, which is the length of the world round about, from Weſt to Eaſt, & againe from Eaſt by Weſt home againe: The firſt degræ whereof beginneth whereas the firſt aforeſaid Meridian croſſeth the Equinoctiall in the very midſt of the Map, and ſo proceedeth Eaſtward unto the number of 180 degræs, which is as farre as you can goe Eaſtward, fith from thence by reaſon of the roundneſſe of the Earth, you muſt nœds turne backe againe Weſtward, untill you come to the 360 degræ, which is the laſt degræ of Longitude, and endeth where the firſt degræ beginneth.

Moreover in the ſaid firſt Meridian, or in ſome other Meridian, and hard by it, are ſet downe the degræs of Latitude, that is to ſay, in breadth of the world both Northern and Southern: for from the Equinoctiall to the North Pole are contained in the foreſaid Meridian 90 deg. and that is called the fourth latitude, and from the Equinoctiall to the South Pole, are contained in the ſaid Meridian, other 90 degræs which is called the South Latitude, and in moſt Maps, the Equinoctiall line is divided and croſſed with 18 Meridians on each ſide of the firſt Meridian dividing the Equinoctiall into 36 ſeverall ſpaces or diſtances,

every

every ſpace containing 10 degrées, and every degrée containeth 60 Italian miles of length.

Moreover, betwixt the Equinoctial and each of the Poles are drawn certaine Circles or lines, called (as I ſaid before) Parallels: of which moſt commonly foure are painted with red Inke, ſignifying the foure leſſer Circles before deſcribed in my Sphеare, whereof the higheſt towards the North Pole, is called the Circle Arctique, being diſtant from the Pole 23 degrées and a halfe, and the loweſt towards the South Pole, is called the Circle Antarctique, being alſo diſtant from the Pole 23 degrées and a halfe: or rather 23 deg. 31′, 30″, according to Tycho Brahe, for that is the greateſt declination of the Sun at this preſent.

Now as touching the other two red Circles, the one lying betwixt the Circle Arctique & the Equinoctiall, is called the Tropick of Cancer, and the other lying betwixt the Equinoctial & the Circle Antarctick, is called the Tropick of Capricorne, and each of theſe two Tropiques is diſtant from the Equinoctiall 23 degrées, 31′, 30″, which is the greateſt declination of the Sun, for betwixt theſe two Tropiques the Sun continually maketh his courſe and returne, as this word Tropique ſignifieth, mounting never higher than the Tropique of Cancer, nor deſcending lower than the Tropique of Capricorne: for which cauſe ſome deſet downe in their Maps, betwixt the ſaid two Tropiques an overthwart line, ſignifying the Ecliptique line, under which the Sun continually paſſeth. Now by helpe of the foreſaid foure Circles the earth is diuided into 5 Zones, that is, one hot, two temperate, and two cold. The hot is contained betwixt the two Tropiques, in the midſt of which hot Zone, is the Equinoctiall line, and of the two temperate Zones, the one lieth betwixt the Tropique of Cancer and the Circle Arctique, and the other betwixt the Tropique of Capricorne and the Circle Antarctique.

Again, of the two cold Zones, the one lieth betwixt the North Pole and the Circle Arctique, and the other betwixt the South Pole and the Circle Antarctique. Now beſides theſe foure ſpeciall Parallels, there be diuers other Parallels drawn on each ſide of the Equinoctial, both Northward and Southward, which croſſing in certaine points the firſt Meridian marked with de-

grees, do shew the true Latitude of every place, and under what Clime or Parallel it is, and also how many houres the longest day of any place under every Parallel is, beginning to account the same, either from the Equinoctiall upward towards the North Pole, alongst the first Meridian, marked with degrees of Northerne latitude, or else from the said Equinoctiall downward towards the South Pole, marked with degrees of Southerne latitude.

Notwithstanding they use most commonly to set downe the number and iust distances of the Climes, Parallels, and houres in the Northerne latitude only, willing the like number of Climes, Parallels, and houres to be accounted in the South latitude, even as they are in the North latitude, and with like distances. And note, that in proceeding towards the Pole from the Parallel, whereas the longest day is 24 houres, they account the Parallel of the longest day, no longer by houres, but by months, that is to say, from one month to six months, whereof wee have spoken before in our Spheare. The numbers of the foresaid Climes, Parallels, and houres, you shall finde set forth in Vopellius Map alongst the first Meridian on the left hand. But he setteth downe the numbers of the longest dayes increasing by months in the uttermost border of this Map on the right hand betwixt the North Pole, and the Circle Arctique. And in that border he setteth downe the number of leagues and miles answerable to every Parallel. whereas also he sheweth the three differences of Inhabitants according to their shadows, that is to say, the Periscii, Heteroscii, and Amphiscii.

Vopellius his Map.

Periscii, are those that dwell in any of the two colo Zones, whose shadow goeth round about them.

Heteroscii be those that dwell in any of the two temperate Zones, whose shadow tendeth at noontide but one way, that is, either North or South.

Amphiscii be those that inhabite the hot Zone, whose shadow tendeth both wayes, that is, sometime North, and sometime South, as is before declared at large in my Spheare.

But in the Map of Gemma Frisius, you shall finde all these things

things ſet forth on the left hand of his Map amongſt the vtter- The Map of
moſt Circles, whereas vpon the Circle Arctique, he ſetteth downe Gemma Friſius.
the twelue ſignes, hauing certaine compaſſed lines, running downe to the Equinoctiall, meeting and concurring all in one point, at the end whereof vpon the Equinoctiall, you ſhall finde the number of houres at which the Sunne riſeth in euery degree of latitude.

Alſo at the nether end of his Map on the left hand, he placeth a halfe Quadrant, which he calleth Directorium nauticum, whereof we ſhall ſpeake hereafter.

And becauſe he would haue his Map to ſerue both Sea and Land, he ſetteth downe a certaine number of Mariners Compaſſes diuided with 32 lines, ſignifying the 32 winds, which do ſhew how euery place beareth one from the other, and by what wind a ſhip is to be directed from one part to another, which thing is alſo obſerued in Mercators Map and others that haue written more lately, and yet nothing ſeruiceable for the Sea, becauſe (as M. Borough, Controller of her Maieſties Nauie, a man moſt skilfull in the Art of Sayling, ſaith) no conſideration is had in the ſaid Maps or Cards touching the variation of the Compaſſe, without the which they can neuer ſet downe any true or iuſt direction.

Now as touching the diuiſion and order of the parts of the Earth, moſt commonly deſcribed in vniuerſall Maps, you ſhall vnderſtand that the ancient Coſmographers, not knowing then the Weſt Indies, nor many other places ſituated both Northward and Southward (which haue bin ſince diſcouered) diuided the whole Earth only into three parts, that is, Europe, Africke, and Aſia, in the deſcription whereof, their Maps neuer extend in latitude Northwards, further than to 63 degrees, as I haue ſaid before in my Spheare, and Southward no further than to 16 degrees of Southerne latitude, or there about, but in longitude from Weſt to Eaſt, beginning the ſame at the Ilands called Inſulæ Canariæ or Fortunatæ, which are ſituated at the Weſt end of Africke, in the Sea called Mare Atlanticum, their deſcriptions do extend to 180 degrees. But becauſe a whole world almoſt hath bin found out ſince theſe times, our moderne

Cosmographers do divide the whole earth into foure parts: that is, Europe, Africke, Asia, and America, which we now call the West Indies. And because men of divers Nations have sayled round about the world, East and West, their late descriptions, do extend in longitude to the whole content of the Equinoctiall, which is 360 degrées: and in latitude Northwards, the same descriptions do extend to 84 degrées: and Southwards, to 66 ½ as you may see in the universall Maps lately set forth by Mercator, and by Barnardus Puteanus, and more lately Ianson and others.

The Maps of *Mercator* and of *Bernardus Puteanus.*

But the ancient and modern do greatly differ in the division of the parts of latitude, aswell Northerne as Southerne, and also in longitude: for, whereas the ancient Cosmographers do divide each latitude into 90 degrées by certaine Parallels, making 9 equall spaces, every space containing 10 equall degrées: in the later Maps last mentioned, you shall find those spaces and the degrées thereof altogether unequall, the first three spaces next the Equinoctiall only excepted, for those differ not above one halfe degrée at the most, but from thence Northward, every space is greater than other, and every degrée in every such space is greater than other, in so much as the fourth space containeth 11 degrées and a halfe of those degrées which are set downe in the first space, and the fift space containeth of such degrées 13 degrées ½, the sixt space containeth of the said degrées 16 degrées ½, the seventh containeth of the same degrées 23 degrées ½, so as that space is twice so broad as the first space, and one halfe degrée more: the eighth space containeth of the said first degrées, 36, further than which eight speaces containing 80 degrées of latitude, their Maps extend not Northward: and they observe the like proportion in the Southern latitude, saving that they extend no farther Southward than to 66 degrées and a halfe.

Againe, they differ in longitude thus: for the moderne Cosmographers do make the first Meridian to passe thorow the Iles called Azores, which do stand 5 degrées more West ward than the Fortunate Ilands do: thorow which Fortunate Ilands, Ptolemie and his followers do appoint the first Meridian to passe.

The cause of which transporting the said first Meridian is because that the Mariners Compasse doth never shew the right

North

North and South, in any other place, but only under that Meridian. Yea M. Borough thinketh that it would ſhew it more truly, if the ſaid Meridian were placed ſomwhat more Weſtward. But in thoſe Cards and Maps that are made according to the Rules of Ptolomie, the ſpaces of Parallels containg the 90 degrées of latitude, both Northward and Southward, are equall, and all the degrées of every ſuch ſpace, are alſo equall. And yet the ſpaces of Parallels, that ſhew the longeſt day in any place, are toward the Pole, every one more narrow than other: for as I have ſaid before in my Spheare, there are three kinds of Parallels, that is, Parallels of the Sun, Parallels of the latitude, and Parallels of the longeſt day. The cauſes why in theſe later Maps, the degrées of latitude are made greater and greater towards the Poles, are ſet downe by Barnardus in his univerſall Map, who ſaith there, that in making the ſaid Map, he had three ſpeciall cares: Firſt, that the places might be ſo ſituated, as they may have both true direction and diſtance, and alſo due longitude and latitude, and as nigh as may be, the ſame very ſhape which they have in the Spheare or Globe, to which end he hath invented a new proportion or habitude of the Meridians to the Parallels, affirming that the Maps before made, are not fit for Navigation, by reaſon of the crookedneſſe and bowing of the Meridians, which by the oblique and overthwart falling into the Parallels, do ſo much diſfigure in the uttermoſt parts, the true ſhape of the Regions, as they can ſcant be known. And as for the Mariners Cards, becauſe their Parallels of latitude are alſo of equal diſtance from the Equinoctial to the very Pole: he ſaith that they muſt needs miſ-fashion the Regions, and make the directions, diſtances, longitudes, and latitudes, to be untrue, and thereby cauſe great errours. Which to avoid, he maketh the ſpaces of his Parallels and degrées of latitude, to increaſe by little and little towards the Pole, affirming that thereby all places ſhall have their true ſhape, and alſo their true directions, diſtances, longitudes, and latitudes.

His ſecond care was, that the Regions & places might have their true quantity and greatneſſe, and alſo true diſtance one from another, wherin he hath taken as he ſaith, greateſt paines

whileſt he did conferre the Cards and Tables of the Caſtilians and Portugals, aſwell amongſt themſelues, as with diuers other Nauigations both printed and written. His third care was to ſhew what parts of the world were known to the ancient men, that the limits and bounds of their Geography might not be vnknowne, to the intent they might haue their due honour and praiſe. And hauing ſhewed what places they did in their time deſcribe, both Eaſt, Weſt, North, and South, in the end of his ſpeech, he affirmeth, that the ancient Coſmographers haue ſet downe in the Eaſt Indies, more places than euer the Portugals haue as yet diſcouered or attained vnto.

This Barnardus Puteanus borne in Bruges, was, by his owne confeſſion, a Cutter or Grauer in braſſe, and alſo a Coſmographer, whoſe Map ſet forth in the yeare of our Lord 1579. doth not differ in any one point that I can finde, from the laſt vniuerſall Map of Mercator that famous Coſmographer, who, as I vnderſtand, was himſelfe alſo ſometime a Cutter and Grauer of ſuch Maps and Globes, as Gemma Friſius did cauſe to be printed in his time, from whom Mercator learned great part of his moſt excellent ſkill in Coſmography.

Truly, when I did firſt behold theſe later Maps, and ſaw that the Parallels towards the Pole were as long as the very Equinoctiall it ſelfe, it ſeemed to me ſomewhat ſtrange. For then I ſaid, that a ſhip in ſayling about the world vnder the Parallel of 60 degrees, ſhould by this meanes make as long a voyage as that which ſaileth about the world right vnder the Equinoctial, which voyage is twice as long. For this containeth in Longitude 21600 miles, which is the whole compaſſe of the earth, and the other containeth in longitude 10800 miles, which is juſt halfe ſo much and no more. But after I had taken better aduiſement thereof, I found by meaſuring with my Compaſſe, that one degree of the Meridian next to the 60 degree of latitude, did comprehend two of ſuch degrees as are ſet downe in the Equinoctiall, and that one degree of the Meridian, croſſing the Parallel that hath 70 degrees of latitude, did comprehend three degrees of the Equinoctiall line, ſo I found the degrees towards the Pole to ware greater and greater, by which degrees I perceiued

ceived their meaning was, to have the longitude of their Parallels to be meaſured, not by the degrees of the Equinoctiall. And by that meanes their Parallels ſhould have each one as nigh as might bee his due longitude proportionally, even as they have in the Globe.

Moreover, the ſhape, quantities, and diſtances of ſuch Countries, as have bene found out of late dayes, muſt nèds be more perfectly ſet forth in theſe Maps, than in thoſe that have bèns made heretofore, becauſe the true longitudes and latitudes of thoſe places were not ſo well knowne then as they are now. Albeit, I feare me, that of many places in the Indies, there are as yet but few longitudes knowne. For it is not ſo eaſie a thing to get the true longitude of every place, as the true latitude thereof. And had not the late markes of Maps bène greatly holpen by the Maps and Cards of ſuch learned Pilots, as have travelled thoſe Countries, I doubt not, but that they ſhould have committed as great errours as thoſe that wrote before them. And of one thing I do aſſure my ſelfe, that in theſe later Maps, more places are deſcribed, than ever were knowne or diſcovered: as for example, the North parts of Groynland, Crockland, Greenland, and America, all which they make Iſlands, and yet never ſailed about them, and ſpecially on the North ſide, as it may be well gathered by the vaine attempting of divers Nations, to finde out new wayes in the North Sea, to the Moluccas, both by Eaſt and Weſt. For being a little entered into thoſe Seas, they are quickly driven back, either by extreame cold, by great yces, or by the raging flods bred of ſnow, and falling from the mountaines of the next continent, and making in ſome places ſuch whirlepooles in the Sea, as if any ſhip chance to come nigh them, it is ſome ſwallowed up.

Neither do I thinke, that King Arthur in his time ever ſent (as it is reported) any of his People to inhabite thoſe Iſlands, being places, in mine opinion, more meet for Whales and monſtrous fiſhes to dwell in, than for men: and ſpecially for Engliſh men, which are not able to ſuffer ỹ cold Winter at Wardhouſe, to which place ſome of our Mariners do ſaile in ſummer ſeaſon every yère. And yet Wardhouſe hath ſcant in latitude 71

degrees, much lesse then are they able to Winter in those places that have seventy seven degrees of Latitude, as the North side of Groynland, and Crockland hath. Moreover, the North side of the Promontory Tabin hath 76 degrees of latitude, which place, whatsoever Plinie saith thereof in his fourth Booke of Histories, yet I beleeve that no Roman came ever there to describe the Promontory. Neither do I beleeve that the Frier of Oxford, by vertue of his Art of magicke, ever came so nigh the Pole to measure with his Astrolabe those cold parts, together with the foure floods, which Mercator and Barnardus do describe both in the front, and also in the nether end of their Maps, unlesse he had some cold Devill out of the middle Region of the ayre to be his guide. And therefore I take them in mine opinion to be meere fables. Truly, if any men should discover those parts, me thinketh that the people of Finmarke & of Wardhouse, or such like people, bordering upon the North Seaes, should best do it, having bodies used to extreme cold. But then being bred in so grosse an ayre, their wits perhaps are too grosse for such a purpose.

The Frier of Oxford.

I remember that William Bourne in his book called the Regiment of the Sea, setteth downe five sundry wayes to saile into Cathay, wherof the first way is by the Cape of good Hope, in the outermost South part of Afrike: The second by the Sea called Mare Magellanicum: The third way is to saile betwixt the North part of America, and the Iles of Groynland and Crockland: The fourth is by Nova Zembla, whereas sir Hugh Willoughby, in seeking that way was frozen to death: The fift way is to saile right under the Pole, that is, first from South to North, untill you be right under the Pole, and then from North to South, alleadging there certaine reasons to prove the three last wayes possible to be as passable as the first two waies well knowne in these dayes, and usually haunted.

The strongest reason that Bourne useth to make the foresaid Seas Navigable, is, for that the Sunne by his long tarrying above the Horizon, so warmeth both Land and Sea, as it cannot be over-come cold againe. But I pray you what heat can the Sun paid to that place above whose Horizon he is never elevated.

bated moze than 23 degrées and a halfe, a verycold winterly heat God wot. And though the cold were not ſo extreame as I take it to be indéed, yet in deſert places, where is there any ſafe harbour, freſh-water, oz any neceſſary ſuccour to be had? Foz in taking ſuch a iourney, let no man thinke to go through without a bait, unleſſe he ſaile in Pegaſus, and hath both wind and tide at will.

Notwithſtanding, I can greatly commend thoſe baliant minds, that do attempt ſuch deſperate voyages, and the rather when they do it foz knowledge ſake, and to pzofit their country, and not altogether foz pzivate gaine and lucre.

But truly foz mine owne part, I thinke it unpoſſible that any man bzed in either of the temperate Zones, oz in the hot Zone, is ever able to continue the whole iourny in any of thoſe thzée wayes: no, though they were much moze paſſable then I take them to be indéed. But if they were paſſable in all reſpects, ſaving foz cold, then I think no nation oz people ſo meet to attempt thoſe wayes, as thoſe which I have already named, oz ſuch like, bozne and bzed nigh unto the Nozth Seas. But leaving theſe matters, let us now ſhew how every one of the foure fozeſaid parts of the earth, that is, Europe, Afrike, Aſia, and America, is bounded, and how many miles each part containeth as well in longitude as in latitude, accozding to ſuch longitude and latitude as Mercator and Puteanus do ſet downe in their Maps.

Europe is bounded ot the Nozth with the Nozth Ocean ſea, & on the South with ỹ Sea called Mare Mediterraneũ, on the Eaſt with the ſlod Tanais, & on the Weſt with the Weſt Ocean ſea. Europe in meaſuring with a right line from the furtheſt part of Ireland on the Weſt, unto the ſlod Tanais on ỹ Eaſt, both places having 52 deg. of latitude, hath in longitude 2166 miles, and in meaſuring with a right line from the furtheſt part of Morea, on the South, whoſe latitude is 35 deg. unto the Nozth ſea ſide, having 72 degrées of latitude, hath in longitude 2220 miles.

Afrike is bounded on the Nozth with the ſtraight ſea Gibralter, and with the ſea called Mare Mediterraneum, & on the South with a Sea which diuideth Afrike from the South land, not yet fully known, and on the Eaſt with the red Sea, oz gulfe of Arabia,

bia, and on the West with the great Ocean Atlantique. Afrik in measuring with a right line from Gambra on the West unto the Cape de Gardafu on the East, both places having ten degr. of North latitude, or there about, hath in longitude 4425 miles. And measuring with a right line from the fiftieth degree of the Equinoctiall unto the Sea, called Mare Mediterraneum, it hath in North latitude thirty two degrees, which being multiplyed by fifty, maketh 1920 miles. In South latitude measuring with a right line, from the fiftieth degree of the Equinoctiall unto the Cape of good hope, called in Italian Capo di buona speranza, and in Latine Caput bonæ spei, it hath thirty five degrees, which being multiplyed by fifty, maketh 2100 miles, which maketh the whole latitude of Africa to be 4020 miles.

Asia is bounded on the North with the North Ocean Sea, and on the South partly with the red Sea, which Sea according to Pomponius Mela, extendeth to the Ile sometime called Taprobana, now Sumatra, which is a famous market-place of al maner of spices: also Asia is bounded on the South with divers other Gulphes and Seas, as you may see in the Map: Againe, on the East it is bounded with the East Indian Ocean, and with the straight Sea of Anian, and on the West, it hath the flood Tanais, and the Fenne of Meotis, and divers Seas, as Bosphorus Cimmerius, the Sea called Mare Euxinum, the Sea Bosphorus Thracius and Propontis, a part of the Sea Mediterraneum, and part of the red Sea or gulfe of Arabia, which divideth Afrik from Arabia Felix. Asia in measuring with a right line, from the mouth of the flood Tanais to the Promontory Tamos, both places having fifty degr. of latitude, hath in longitude 4284 miles, and in measuring with a right line from the 150 deg. of the Equinoctial unto the Promontory Tabin, Asia hath in North latitude seventy five degr. which being multiplyed by fifty, maketh 4500 miles.

America is bounded on the North with the North Ocean sea, and on the South with the sea called Mare Magellanicum, on the East with the great Ocean Atlantique, & on the West with the West Indian Ocean, & the strait sea of Anian. America in measuring with a right line from the strait of Anian to the furthest part of Estotiland upon the 64 degree of latitude, hath in longi-

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tude 164 degrées, which maketh 3264 miles, and in meaſuring with a right line from the 270 degrées of the Equinoctiall unto the North Sea, it hath in North latitude 76 degrées which maketh 4560 miles, and yet the quantity of the ground deſcribed in the Map, is not ſo great as the other by a ſeventh part: wherin I can very well excuſe the Map-makers, not having perhaps as yet the true longitude of that part of America.

Finally, in meaſuring with a right line from the 305 degrée of the Equinoctiall unto the Sea called Mare Magellanicum, it hath in South latitude fifty three degrées, thirty minutes, which maketh 3210 miles.

Now if you would know what Kingdomes, Regions, Cities, Mountains, Flouds, Lakes, alſo what Seas together with their Ilands, Ports, Capes, Points & Bayes do belong to every one of the foreſaid 4 parts, then ſtudy well theſe modern Maps: and with your eye you ſhall behold, not only the whole world at one view, but alſo every particular place contained therein. Which to deſcribe at the full in writing, would require a long time, wherfore leaving that to your owne induſtry, I will ſhew you how to finde out the longitude and latitude of any place in the Map. Alſo to know how one place lyeth from another, and with what wind you have to ſayle from one place to another. And finally, how to finde out the true diſtance betwixt place and place, in which things the chiefe uſe of Maps doth conſiſt.

How to finde out the Longitude and Latitude of any place contayned in the Map.

And firſt you have to underſtand, that the Meridians which you ſée in the Map, do ſerve for divers purpoſes. For you learne thereby that it is noon-tide or mid-day, ſooner to one place than to another, by marking what Meridian is more towards the Eaſt, which the Sun alwayes toucheth ſooner than that Meridian which is more towards the Weſt. Alſo by the Meridians you know how the Eclipſe of the Moone appeareth ſooner to one place than to another, and with what variety of time.

For they whoſe Meridian is toward the Weſt, do ſée the Eclipſe of the Moon ſooner than they whoſe Meridian is more towards the Eaſt, whereas in very truth the Eclipſe of the Moone is ſéene to all places (where it can be ſéen) at one very inſtant of like greatneſſe, & yet ſéemeth to be ſéen later or ſooner, by reaſon

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of the diuerſity of the time of the day, in places ſtanding Eaſt or Weſt one from another. And if the diſtance betwirt thoſe two Meridians do contayn 15 degrees of the Equinoctiall, then the Eclipſe appeareth to be ſooner to the one, than to the other by one whole houre. For euery 15 degrees maketh an houre, and therefore look how many 15 degrees you finde betwirt the two Meridians, ſo many houres are to be accounted. And if you finde fewer degrees, then the time of the Eclipſe is to be ſhortned accordingly, and by attributing 4 minutes of an houre to one degree (for foure times 15 maketh 60 minutes, which is alſo one houre) you may make your account ſo ſmall or great as you will. And note alſo, that you may conceiue to be in the Map, as many Meridians as there are degrees in the Equinoctiall.

As for the Eclipſe of the Sunne, it is ſeen neither generally nor fully at one ſelfe-ſame time, nor yet of the ſame greatneſſe in all places. Indeed it appeareth ſooner to the Weſtern Countries, than to the Eaſtern. But the diuerſity of the time of appearance doth depend not only on the number of Meridians betwirt the two places, but alſo on the ſwift or ſlow motion of the Moone, which comming betwirt us and the Sunne, taketh the light of the Sunne from us.

Moreouer, by the Meridians you ſhall know what longitude any place in the Map hath, by doing thus: Firſt ſet the one foot of your Compaſſe in the place it ſelfe, and the other in ſome Meridian that is next vnto it, whether it be on the left or right hand, it maketh no matter: and from thence draw down your Compaſſe, following ſtill that Meridian vntill you come to the Equinoctiall Line, and there mark vpon what degree of the Equinoctiall that foot of your Compaſſe which you did firſt put in the place, doth reſt, and there make a prick. That done, count how many degrees that is diſtant from the firſt Meridian, and that is the true longitude of the place: and that longitude ſerueth to all the places that be vnder that Meridian, though they be neuer ſo farre diſtant one from another, North and South.

Now if you would know the latitude of any place in the Map, that is to ſay, how far it is diſtant from the Equinoctiall, either Northward or Southward, either of which latitudes contayn-

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neth 90 degrées, then do thus: ſet the one foot of your Compaſſe upon the very place, and the other upon that Parallel which is next it, whether the Parallel be above it or beneath, it maketh matter, & draw your Compaſſe from that place, following ſtill that Parallel, untill you come to the Meridian, which is marked with the degrées of Latitude, which Meridian in the later Maps, ſtandeth ſomewhat more Weſt than the firſt Meridian doth. And marke upon what degrée that foot of your Compaſſe, which you did draw from the place doth reſt, and there make a prick, that done, count how many degrées that prick is diſtant from the Equinoctial, and that is the true Latitude of that place. And the like Latitude have all they that dwell under that Parallel, how farre ſoever they dwell aſunder, Eaſt and Weſt. And by knowing the Latitude of any place, you may quickly find alſo in ſome Maps, under what clime or Parallel ſuch place is ſituated, and of how many houres the longeſt day is there, as in the Map of Vopellius, of Gemma Frizius, and divers others. But in theſe later Maps ſuch things are not ſet forth, wherefore not having the other Maps, you may reſort to the Tables ſet down in my Spheare, which do ſhew all ſuch things at the full.

Now to know how one place beareth from another, and with what wind a ſhip is to be directed from one Port unto another, & alſo what diſtance is betwixt two places, that is, how many miles one place is diſtant from another, the later Coſmographers, as Mercator, Bernardus Puteanus, & divers others, have inuented a new Inſtrument called Organũ directoriũ, which they ſet down in their Maps, together with the uſe therof, but in mine opinion not plainly enough for moſt mens capacity. This Inſtrument containeth two Quadrants of a Circle, having the names of the winds written therein: And they call the upper Quadrant Organum Superius, and the nether Quadrant Organũ Inferius. Which 2 Quadrants have two lines marked with degrées, and are joyned together with a right angle, of which two lines, the ſtanding or hanging line on the left hand, doth ſignifie the firſt Meridian, & is marked with 75 unequall degrées of Latitude, in ſuch proportion as the middle Meridian of the Map hath. The other line which lieth overthwart, ſignifieth the Equinoctiall,

Organum directorium, with the deſcription and uſe thereof.

noctiall, and is marked with ninty equall degrées of Longitude. But the spaces of the Parallels of latitude, are in number seven and a halfe, every whole space containing ten degrees: and the halfe space but five degrées, which spaces are wider and wider towards the Pole, and of like proportion to those of the Map.

And note by the way, that the highest right line that goeth from the first Meridian towards your right hand, is the East line, and the nethermost line signifying the Equinoctial is the West line For the upper Quadrant commeth towards you from East to South, & the nether Quadrant goeth from you towards the left hand from West to South, and in the Center of each Quadrant, must bee put a long thred to shew the diréction from place to place. The use of this Instrument is thus: first having found out in the Map the severall Longitudes & Latitudes of two places, in such order as is before taught, séeke the latitude of the first place in the first Meridian, and there make a mark. I call here the first place, that from whence you go, and the second that to which you go. That done, séek out in the said Meridian, the Latitude of the second place, & there make another mark. And from that marke of the second place draw a right line towards your right hand, so as it may be a Parallel to the Equinoctiall line. Then take the difference of the two Longitudes, by subtracting the lesser out of the greater, & séek out the degrées of that difference in the Equinoctial line, & there make a mark, from which mark draw a right line that may be a Parallel to the first Meridian. And whereas this line crosseth the first line, there set down a mark, then draw a right line from the mark of the first place, so as it may passe through the crossing point. That done, if the latitude of the first place be greater than that of the second place, make a Parallel to that line with the thred of the uper Quadrát but if the latitude of the first be lesser than the second, then make a Parallel unto the said line with the thred of the nether Quadrant, which with the helpe of your Compasse you shal easily do. And that thred being stretched out amongst the winds, wil shew by what wind the second place beareth from the first. And the opposite wind is the director whereby you have to saile. Yet neither Mercator, nor Barnardus do plainly shew how to find out

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the true diſtance of two places by this Inſtrument, nor yet do ſet downe in their Maps, either ſkale or trunk, to take the diſtance betwixt two places with the Compaſſe, as moſt commonly all other Maps and Marines Cards have, but do refer the plaine declaration therof to other Bookes and Tables, which I have not yet ſeene: and therefore in the meane time I thought good to ſet downe according to Barnards rule, this briefe way of finding out the diſtance of any two places whatſoever is ſet downe in their Maps. Firſt, with your Compaſſe, take the juſt diſtance of the two latitudes upon the firſt Meridian, which is otherwiſe called the difference of the latitude. And having laid a Ruler or threed to the places, look how many times the foreſaid diſtance, or difference taken with your Compaſſe, is comprehended in the ſpace that lyeth betwixt the two places, and by ſo many times multiply the ſaid difference, the Product wherof being multiplyed againe by ſixty, will ſhew how many miles the one place is diſtant from the other. As for example, the diſtance or difference betwixt the two latitudes of London and Ieruſalem, is nintene degrees or thereabouts, which being taken with your Compaſſe, you finde to be two times contayned in the ſpace betwixt Hieruſalem and London. Wherefore in multiplying nintene degrees by two, you finde the Product to bee thirty eight, which being multiplyed by ſixty, maketh 2280 miles, and ſo far is Hieruſalem from London by a right line. But if in meaſuring the diſtance betwixt two places with your Compaſſe, there remaine any odde ſpace not fully anſwering the firſt wideneſſe of your Compaſſe, then take that odde ſpace with your Compaſſe being ſtraightned and made fit thereunto, and look how many degrees the ſaid odde ſpace comprehendeth in the firſt Meridian, about the midſt of the degrees of the foreſaid difference of latitude, and adde thoſe degrees alſo to the reſt which you have already meaſured and multiplyed, and by multiplying the whole ſumme by ſixty, you ſhall have the true diſtance.

Againe, it may be that the two places do not differ at all in Latitude, but only in Longitude. For as I have ſaid in my Spheare, two places may differ three manner of wayes, that is, in Latitude only, in Longitude only, or in both. And there I do ſhew how every one is to be meaſured. But

But becauſe that order of meaſuring is ſomewhat vnſe, to ſuch as are not very well exerciſed in Arithmetick, and do not knowthe vſe of that Table of ſignes called in Latine Tabulæ ſinuum, I thought good to ſet downe here a more eaſie way of meaſuring, though perhaps not altogether ſo juſtly, and yet without any great errour. Wherefore, if the two places do differ both in longitude and latitude, then you muſt do as before is taught: But if they differ only in latitude, then you have no more to do, but to multiply the difference of the two latitudes by ſixty miles, and if there be any odde minutes, then to allow for every minute one mile. As for example, Compoſtella and Lisbone, two Townes, the one in Spaine, the other in Portugal, have one ſelfe-ſame longitude differing only in latitude, which difference is foure degrees and twenty minutes.

Here if you multiply foure by ſixty, it amounteth to 240 miles, whereunto by adding twenty miles for the twenty minutes, you ſhall find the whole ſum to be 260 miles, which is the diſtance by a right line betwixt Compoſtella and Lisbone.

But if the two places having one ſelfe-latitude, do differ only in longitude, then look how many ſuch degrees as are of equall quantity to the laſt degree of the ſame latitude, are contayned betwixt the two places by a right line, and by allowing for every degree ſixty miles, you ſhall have the true diſtance, or at the leaſt not much differing from the truth. And if you ſee that the two places in the Map do ſtand far aſunder, then for the more ſpeedineſſe, take with your Compaſſe five ſuch degrees at once, being firſt pricked upon a peece of paper, which is juſt 300 miles and at that widnes meaſure the ſaid ſpace, and if there remaine at the leaſt any odd ſpace, then ſtraighten your Compaſſes, & fit them to that odde ſpace, and looke how many of the foreſaid degrees that comprehendeth, and having multiplyed the ſame by ſixty, adde the Product thereof to the former ſumme.

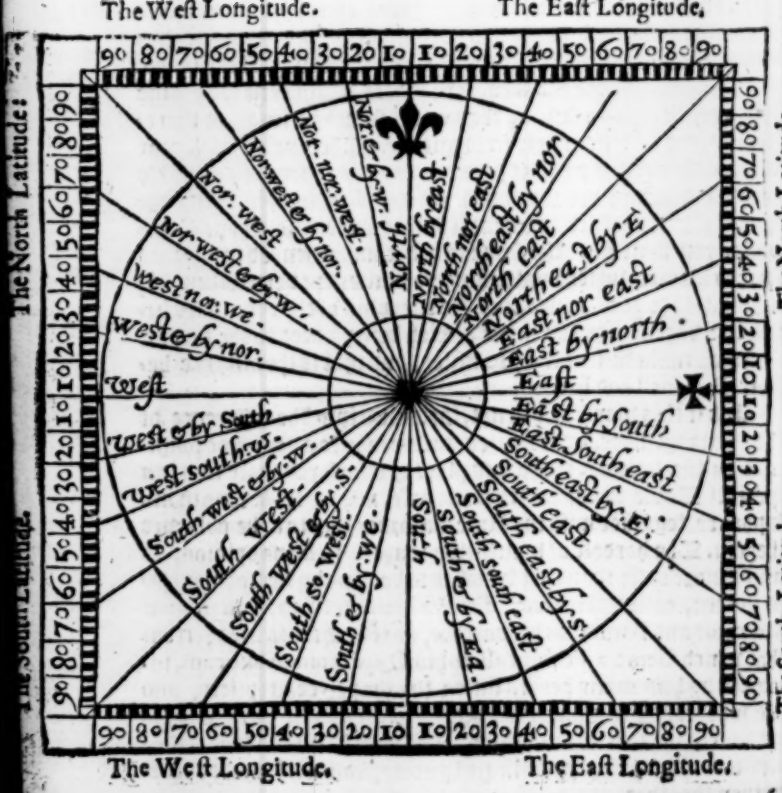
As for example, Compoſtella and Conſtantinople, having one ſelfe-ſame latitude, that is, forty three degrees of North latitude, do differ only in longitude: Here with my Compaſſe I prick upon a peece of paper, five degrees like in quantity to the laſt, & the uppermoſt degree of the foreſaid forty three degrees, & meaſuring

with

with the wideneſſe of my Compaſſe the ſpace betwixt the two places, by a Ruler or right line, I find that ſpace to comprehend the foreſaid wideneſſe of my Compaſſe 6 times, which maketh 1800 miles, and that there remaineth an odde ſpace containing 3 of the foreſaid degrees, that is, 180 miles, which being added to the former ſumme, maketh in all 1980 miles, which is the diſtance betwixt Compoſtella and Conſtantinople. Alſo if you would know the diſtance betwixt two Townes in Africk, the one called Bubonel, ſtanding upon Capo viride, and the other called Ercoco, ſtanding hard by the red Sea, both places having one ſelfe ſame latitude, that is to ſay, 14 degrees of North latitude, or thereabouts, and do differ onely in longitude. Then prick with your Compaſſe upon a peece of paper 5 degrees, every one equall to the laſt degree of the foreſaid latitude. And in meaſuring the ſpace betwixt thoſe two places with that wideneſſe of your Compaſſe, you ſhall find the ſame to bee comprehended in the ſaid ſpace 12 times, which by allowing 300 miles to every wideneſſe, amounteth to 3600 miles, and the overplus of the odde ſpace being two degrees, is 120 miles, which being added to the former ſumme, maketh in all 3720 miles, and that is the diſtance betwixt Bubonell and Ercoco.

And if this way like you not, then multiply the difference of the two longitudes, by the miles anſwerable to a degree of longitude in the latitude of the ſaid places, which you ſhall find in a ſpeciall Table made for that purpoſe, and is ſet downe in my Spheare, together with the Rule and order that is to be obſerved therein. The hardeſt of which two wayes, in mine opinion, is much more eaſie than that which is to be done by the former Inſtrument, called Organum directorium. Which Inſtrument Mercator and Barnardus did borrow, as it ſeemeth to mee, from that which Gemma Friſius called his Quadratum Nauticum, invented by him many yeeres ſince: the ſhape, deſcription, and uſe whereof, I thought it not amiſſe to ſet downe here, and the rather for that, in mine opinion, it ſheweth both the true courſe and direction to any place more ſpeedily, and with more facility then the other.

Here followeth the Mariners Quadrant.



A deſcription of Gemma Friſius *his Inſtrument, called Quadratum Nauticum.*

THis ſquare, by two right lines, called Diameters, croſſing one another with right Angles in the very Center, is divided into foure equall quarters, and within the ſaid ſquare upon the ſaid Center, is drawn a Circle, which by meanes of the two foreſaid Diameters is alſo divided into foure Quadrants, and every Quadrant is ſubdivided with right lines into eight parts, ſo as in al, there be two and thirty lines, ſignifying the two and thirty winds of the Mariners Compaſſe. Every line having his proper name of winde written thereon. And note that the right line, which is drawne right downe in the middeſt of the ſquare, ſignifieth the Meridian, ſhewing the North point above, and the South point beneath, and the other right line, croſſing the ſame in the Center, ſignifieth the Equinoctiall line, which ſheweth the Eaſt point on the right hand, and the Weſt point on the left hand, and the Circle it ſelfe ſignifieth the Horizon.

Now you have to underſtand, that from the Equinoctiall line upwards, the two ſides of the ſquare are divided each of them into 90 degrees of North latitude, and the other two ſides from the Equinoctiall downward, are likewiſe divided on both hands into 90 degrees of South latitude. Then the head or front, and alſo the baſe of the ſaid ſquare is divided in the middeſt by the foreſaid Meridian line into 2 equall parts, whereof the firſt proceeding from the ſaid Meridian towards the right hand, is divided as well above as beneath into 90 degrees of longitude, and that is called the Eaſt longitude, and the other part proceeding from the ſaid Meridian towards the left hand, is likewiſe divided as well above as beneath into 90 degrees of longitude, and is called the Weſt longitude. The uſe of which inſtrument is thus: Firſt, knowing by ſome Table or Map, the longitude and latitude of two places, take the difference of both by ſubtracting the leſſer out of the greater: And if the Longitude of the ſecond place be

greater then the firſt, ſeeke the difference thereof in the front, and alſo in the baſe of the Eaſt longitude on the right hand. But if the longitude of the ſecond place be leſſe then the firſt, then ſeeke the difference thereof in the Weſt longitude on the left hand. And here, as before, I meane by the firſt place that from whence you go, of which two places, the firſt is alwayes ſuppoſed to bee in the very Center of the Circle, and the other is to be found out thus: firſt, having ſought out the degrées of the difference of the longitude, as well in the upper part, as in the neather part, and marked the ſame with one prick above, and another beneath, apply your Ruler or a thred to thoſe two pricks, or elſe draw a ſecret right line from the one prick to the other, by a Ruler. That done, ſeeke out the difference of the two latitudes on both ſides of the ſquare, that is to ſay, if the ſecond place hath greater latitude then the firſt, then you muſt ſeeke the difference in the North latitude, if leſſe, then ſeeke that in the South latitude. And having marked the ſame on both hands, by ſetting downe on each ſide a prick, draw a ſecret right line from marke to marke, and where the laſt line croſſeth the firſt line; there make a marke, for there ſtandeth the place whereto you would go. Which if you would know how it beareth from the firſt place, then lay your Ruler both to the Center, and alſo to that marke, drawing a right line paſſing thorow the Center, and alſo thorow the ſaid marke from the one ſide of the Circle to the other, or elſe ſtretch a thred thorow the Center and the marke, and on that ſide that the marke is, you ſhall ſee the name of the winde that ſheweth how the ſecond place beareth from you, the oppoſite point whereof is the winde, whereby you haue to ſaile. As for example, if you would know how Venice beareth from London.

Now, if you ſeeke in the Map, you ſhall find London to haue in longitude 23 degrees and 0 minutes, and in latitude 51 degrees and 32 minutes. Againe, you ſhall find Venice to haue in longitude 36 degrees, and 30 minutes, and in latitude 45 degrees and 15 minutes, or thereabouts.

The difference of the longitude is 13 degrees & 30 minutes, which becauſe the longitude of Venice is greater then the longitude of London, you muſt ſeeke it out in the Eaſt longitude on

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the right hand, and marke the ſame both aboue and beneath. Againe, the difference of latitude is 6 degrees, and 17 minutes. Which becauſe Venice hath the leſſer latitude, ſeeke that out in the South latitude, marking the ſame on both hands. That done, lay two threds, or elſe draw two right croſſe lines from the foreſaid markes, and where thoſe two threds or lines do croſſe, make a marke, which marke ſignifieth the place whereunto you would go, which is Venice.

Then from the one ſide of the Circle to the other, lay a Ruler, or thred, paſſing thorow the Center, and the ſaid marke made for Venice, at the end of which thred, Ruler, or line, on the right hand, you ſhall ſee the winde which ſheweth how Venice beareth from London, and on the left hand the winde whereby you have to saile, if the ſpace betwixt the two places were all Sea. For in ſailing by Sea, you may not thinke to go alwaies by a right line, but often to change your courſe according as either mainland, headlands, Iles, currents, ſands, rocks, or ſuch like impediments ſhall giue occaſion: and therefore though your right courſe from London to Venice, is to go South-eaſt and by Eaſt, yet being come out of the Thames to Douer, your courſe from thence to the Cape of Britaine is Weſt South-weſt. And from thence to the Cape Finiſterre in Spaine, it is South-weſt and by South. And from thence to the Cape S. Vincent in Portugall, you go right South: and from thence to Gibralter almoſt Eaſt South-eaſt. Againe, from Gibralter to the South point of Sardinia, your courſe is almoſt Eaſt and by North. And from thence to the South point of Sicilia, almoſt Eaſt South-eaſt: and from thence to Corfu, your courſe is juſt North-eaſt, and from thence to Venice, you turne againe North-weſt.

Thus you ſee that in going by Sea, one courſe doth not hold, no nor yet in going by Land, ſith mountaines, riuers, and lakes, may put you out of your right courſe, and yet it is neceſſary to know how the place, whereunto you go, beareth from you, to the intent that being out of your way, you may alwaies the better direct your courſe right againe to the ſame.

Moreover, Gemma Friſius ſaith, that by this Inſtrument you may alſo find out the difference of longitude betwixt the two

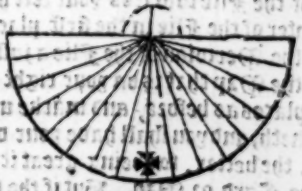
places from whence and whether you go, so as you know before how the second place beareth from the first, and also the difference of their latitudes. As for the latitude of each place, you may easily find the same with your Astrolabe, Quadrant, or crosse staffe, by taking therewith the Meridian altitude of the Sunne, or the highest altitude of some starre that you know: the order whereof, I have set downe in my Spheare. And the coast of the Country and place whereunto the ship is to be directed, is commonly well knowne to the Mariners how it beareth from the first, and specially having a prosperous winde.

Then knowing these two things, you must do thus: First, having drawne a secret line or three, from the difference of the two latitudes, placed according to the Rule of greater and lesser, before set downe, and marked on both sides of the Instrument: draw another three, or else lay a Ruler so as it may passe through the Center, and the line of the winde, or coast, whereon the second place beareth from the first. And whereas those two lines or threes do touch, make a marke, and then lay a Ruler, or extend a three from the upper line to the nether line of longitude, so as it may passe hard by the last marke, and then the three or Ruler so laid, will shew you the difference of longitude betwixt the two places. And by this meanes Gemma Frisius saith, that the Mariners may easily correct the longitudes of places as they saile: but how truly, I referre that to the skilfull pilots.

But for mine owne part, having to seeke out, in these latter Maps, the way by sea or Land to any place, I would use none other Instrument of direction then halfe a Circle, divided with lines like a Mariners Flie, in such sort as you see in this figure.

The

The ſhape of the Flie, the uſe whereof followeth.



This Flie containeth two quarters of the Mariners Compaſſe, the middle line whereof marked with a Croſſe, ſignifieth the line which runneth Eaſt and Weſt. For if the place whereto you go, be on your right hand, then the Croſſe ſignifieth the Eaſt Point, but if it bee on your left hand, then turning the Flie towards your left hand, the Croſſe doth ſignifie the Weſt point, and the right downe line, croſſing the foreſaid middle line with right Angles in the very Center is the Meridian line ſhewing the North and South, according as you turne the Croſſe, Eaſt or Weſt.

The uſe of which Flie, is thus: If it, with a pin or a needle being thruſt thorow the Center of the Flie, pricke the pin downe in the very place from whence you go, called before the firſt place, and if the ſecond place be on your right hand, then turne the Croſſe of your Flie that way, but ſo as the Meridian of the Flie may be a true Parallel to the nert Meridian of the Map that is on your left hand, which your Compaſſe will quickly perfome by taking therewith a juſt ſpace at both ends of the Flie, betwixt the two foreſaid Meridians, that is to ſay, the Meridan of the Flie, and the nert Meridian of the Card or Map.

That done, extend your thred so as it may passe thorow both the Center of the Flie, and also thorow the second place, and then looke vpon what winde or coast of the Flie the thred lyeth, and that winde sheweth how the second place beareth from you. And the opposite winde thereof sheweth by what winde you haue to saile thither.

But if the second place bee on your left hand, then you must turne the Crosse of the Flie towards your left hand, and hauing set downe the Center of the Flie in the first place, and with your Compasse made the Meridian of the Flie a iust Parallel to the next Meridian of the Map that is on your right hand, lay your thred to the two places as before, and marke vpon what winde of the Flie it striketh, and you shall haue your desire. The lesser that your Flie is, the better, for being great it would couer too many places of the Card or Map. But if the two places stand so nigh together, as the Flie doth cover them both, then hauing set downe your pinne in the first place, make your thred with a noose, and hauing put the same ouer the pinne, draw the thred thorow the second place, somewhat beyond the Compasse of the Flie, and hold it there fast vntill you haue also put the Center of the Flie ouer the said pinne or needle, and duely placed the same in such forme as it is before taught, and in so doing, that line of the Flie, which lyeth vpon the thred, will shew your course and direction as well as if the thred lay aboue the Flie.

Truly, I do thinke, the vse of this Flie a more easie and speedy way of direction, then the manifold tracing of the Maps or Mariners Cards, with such a number of crosse lines, as commonly are drawne therein, causing rather a confusion then otherwise: for in such Cards as are made with right Meridians, you shall find the Flie to be much more seruiceable then these manifoldlines.

The

The uſe of Ptolomies *Tables.*

THus much touching the uſe of Maps, and Cards. Now, according to my promiſe, I will briefly ſhew you the uſe of Ptolimes Tables, or of any other Table made in that forme. The chiefeſt point whereof is readily to find out any place that you ſeeke, and to know where it ſtandeth: For the accompliſhment whereof, you muſt firſt know what longitude and latitude that place hath.

The longitudes and latitudes of all places, deſcribed by Ptolomie, are ſet downe in his ſecond, third, fourth, fift, ſixt, and ſeventh Booke of Geographie. For, in his ſecond Booke he deſcribeth the Weſt part of Europe, containing Ireland, England, and Scotland, Hiſpania, Gallia, Germanie, Hungarie, and Slavonie, In his third Booke he deſcribeth the Eaſt part of Europe, as Italie, Scicilia, Corſica, Sardinia, Sarmatia, Taurica, Peninſula, Datia, Miſia, Thracia, Macedonia, Achaia, Peloponneſus, Candia, Rubia, and divers other Lands and Illands. And he containeth all Europe in ten Tables. In his fourth Booke he deſcribeth Afrike, that is to ſay, ſo much as was knowne in his time, containing the ſame foure Tables. In his fift, ſixt, and ſeventh Booke, he deſcribeth all Aſia, and the Eaſt Indies, whereof hee maketh 12 Tables, and in deſcribing any Region or Province, he ſheweth how it is bounded both North and South, Eaſt and Weſt. And alſo what notable Cities, Floods, Lakes, or Mountaines, be in every Region, and therewith ſetteth downe the longitude and latitude of every place: to which his Booke, divers have made certaine Alphabeticall Tables, containing the names of all the places that are mentioned in the ſoreſaid Books, ſhewing in what leafe to find the ſame: to the intent that you may the more readily find out, not only the place, but alſo the longitude and latitude thereof, and in what Table it is contained.

Notwithſtanding, I know by good tryall, that there are a number of places mentioned in the ſaid Bookes, which you ſhall not find in the foreſaid Alphabet.

Wherefore I wiſh, that Mercator, Ortellios, Barnardus, Brugenſis, or any other of the Coſmographers, and ſetters forth

of

of Maps and Cards, would take the paines to make a generall Alphabet containing all the names that are to be found and knowne, both ancient and moderne, of Regions Cities, Seas, Floods, Lakes, Rivers, Ports, Bayes, Headlands, Capes, Mountaines, and all other notorious places, contained in their Maps and Cards, together with the true longitude and latitude, annexed to every place, and agreeable to their Maps, to the intent, that every man delighted with the reading of Hiſtories, may in their Maps, both generall and ſpeciall, eaſily find out any place that he ſeeketh. Which worke, in mine opinion, would be moſt thankefully received of all thoſe that delight in Geographie, to the great commendation and praiſe of the Author thereof.

For though Ptolomie, Appian, Gemma Friſius, Caſtaldus, Oroncius, Munſterus, Ortellius, and others, have ſet downe certaine names both Antient and moderne, together with their longitudes and latitudes, yet they are but very few in compariſon of all the names that are wanting, yea or of thoſe that are comprehended in their owne Cards and Mars, all which Maps I would wiſh to agree in their longitudes and latitudes: for otherwiſe a man ſhall hardly find the place which he ſeeketh.

Wherefore I pray God with all my heart, that ſome good man that is a skilful Cosmographer may ſhortly travell herein, vnto the profit of all Students in Geographie.

But now to returne to my matter, which is to ſhew how to find out any place contained in Ptolomies Tables, I ſay that you muſt firſt find out the name of the place in the Alphabet, and that will direct you to the booke wherein it is ſet downe, together with the longitude and latitude thereof. And there alſo you ſhall find in what Table it is contained.

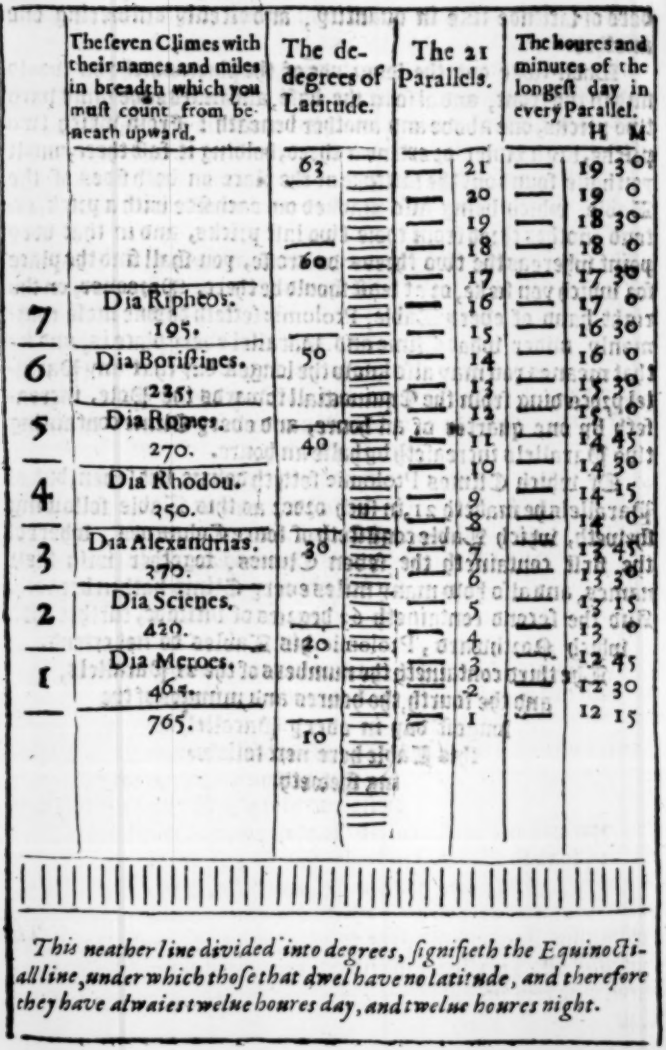
Then having taken a note of the longitude and latitude, and alſo the number of the Table wherein it is to be ſought, reſort to that Table, be it in Europe, Affricke, or Aſia. In the front of every which Table, and alſo in the baſe are ſet downe certaine numbers of longitudes, in ſuch ſort as the uppermoſt and nethermoſt bee like numbers, and do directly anſwere one another. Againe, on both ſides of the Table are ſet downe certaine num-

bers

bers of latitude like in quantity, and directly anſwering one another.

Then ſeeke out the longitude of the place which you would find in the front, and alſo in the baſe, and marke the ſame with two pricks, one above and another beneath: From which two pricks, lay a Ruler or extend a thred, holding it faſt there, untill you haue found out the latitude of the place on both ſides of the Table, which being alſo marked on each ſide with a prick, extend another thred from thoſe two laſt pricks, and in that very point whereas the two threds do croſſe, you ſhall find the place for which you ſeeke, or at leaſt ſhould be there. Moreover, on the right hand of every Table, Ptolomie ſetteth downe moſt commonly, under what Clime and Parallel every place is, and by that meanes you may alſo know the longeſt day that any Parallel preceading from the Equinoctiall towards the Pole, increaſeth by one quarter of an houre, and every Clime containing two Parallels increaſeth by halfe an houre.

Of which Climes Ptolomie ſetteth downe but ſeuen, but of Parallels he maketh 21, in ſuch order as this Table following ſheweth, which Table conſiſteth of foure Columnes, whereof the firſt containeth the ſeuen Climes, together with their names, and alſo how many miles every Clime hath in breadth. And the ſecond containeth 63 degrees of latitude, further then which Northward, Ptolomie his Tables do not extend. The third containeth the numbers of the 21 Parallels, and the fourth, the houres and minutes of the longeſt day in every Parallel, as this Table here next following ſheweth.



This neather line divided into degrees, signifieth the Equinoctiall line, under which those that dwel have no latitude, and therefore they have alwaies twelue houres day, and twelue houres night.

But you haue to vnderstand that whereas Ptolomy maketh the farthest North part of his seventh Clime called Dia Ripheos, to haue but 50 degrees and 30 minutes of latitude, the moderne Cosmographers do allow to those mountaines 70 degrees of latitude, affirming the same to bee those selfe mountaines which are otherwise called Montes Hiperborei, which because they enclose a great part of the North side of the world, are called Orbis terræ cingulum, that is to say, the girdle of the world, the wrong latitude whereof, and of diuers other, I thinke Ptolomy had from other, and not from himselfe.

For being brought up in so warme a soyle as Alexandria standeth in, he could neuer endure to go so farre Northward, to take the latitude of those cold Riphean Mountaines, and therefore if you list to know what latitude doth truly belong vnto euery Clime and Parallel, then resort to Oronc. his Table of Climes and Parallels, set downe in my Spheare, which sheweth how many degrees of Latitude euery Parallel hath, together with the longest day, euen from the Equinoctiall to the very Pole: wherefore I leaue to speake heere any further thereof, and so for this time end this Treatise.

Now heere followeth the order of making *Ptolomie* his Tables and of all other Maps, both vniuersall and particular.

Hea

How to describe in manner of a Table, like unto the Tables of Ptolomie *any Country or Region, and all the places contained therein by knowing their Longitudes and Latitudes.*



So for example you would describe the Countrie of France, which containeth in latitude 10 degrées, and in longitude 16. Here first you must drawe a perpendicular line thorow the middest of your Table or Card from head to foot, signifying the Meridian or Arletrée of the world, marked with the letters E F, as you may see in the former Table of France, and divide that line into tenne equall parts, then drawe two Parallel lines: whereof the one must crosse the said line above in the point e, with right Angles. And the other Parallel must crosse it againe beneath in the point f, with like angles, and marke the uppermost Parallel with A B, and the neathermost Parallel with C D. Then with your Compasse take one of the 10 parts of the said line e, f, which is one degrée, and set that downe by it selfe, dividing the same into 60 minutes, as the short line G H. set downe on the right hand of the former Table of France doth shew: And having learned by some Table or Mappe, that the farthest part of France Northward, thorow which the Parallel A B passeth, is distant from the Equinoctiall 52 degrées, and that the South Parallel C D is distant from the Equinoctiall 42 degrées, and also having learned by another Table, called the Table of miles here following, that to every degree of the Parallel 42 marked with A B, do belong 37 miles, and that to every degrée of the Parallel marked in C D, belongeth almost 45 miles. Take therefore with your Compasse from the short line G H, 37 parts or minutes, and keeping your Compasse at that wideneſſe, divide the Parallel A B into 16 equall spaces answerable to that wideneſſe, (that is to say) 8 parts on each side of the Meridian E F, at which Meridian you must beginne to measure towards either hand, both right and left, setting downe a pricke at the end of every such space. Then for the South Parallel C D, take from the

the ſhort line GH 45 parts or minutes, and divide that Parallel into 16 ſpaces anſwerable to that wideneſſe of the Compaſſe, ſetting downe eight ſuch ſpaces on each ſide of the Meridian EF, beginning to meaſure from the Meridian EF, as before, and ſet downe at the end of every ſuch ſpace a pricke, then from thoſe prickes, ſo ſet in each of the two Parallels AB, and CD, draw right lines from pricke to pricke, and thoſe ſhall bee Meridians, ſhewing as well the longitude of the whole Region, as of every particular place contained therein.

Then like as the Meridian EF is divided into 10 equal parts: ſo divide againe into the like parts each of the two outermoſt Meridians, as well that on the left hand, as that on the right hand, ſetting downe a pricke at the end of every ſuch ſpace, and from pricke to pricke draw right lines paſſing thorow all the Meridians, and thoſe ſhall bee the Parallels, and in the outermoſt ſpaces write the numbers as well of longitude as of latitude beginning your longitude at the outermoſt Meridian on the left hand, which is the furtheſt Meridian Weſtward as well above as beneath:

And becauſe that the furtheſt Meridian Weſtward is foureteene degrées diſtant from the Meridian of Inſulæ fortunatæ, which of all the ancient Geographers is counted the firſt Meridian: remember therefore to ſet downe in the firſt ſpace on the left hand, as well above as beneath, in Arithmeticall figures 15, and in the ſecond ſpace 16, and in the third ſpace 17, and ſo proceed from ſpace to ſpace till you come at 30, for betwixt 14 and 30, are contained 16 degrees, ſo haue you the whole longitude of France which is 16 degrees.

Thus having ſet downe the numbers of the degrees of latitude, beginning at each end of the South Parallel CD, and ſo proceede upward alongſt the two outermoſt Meridians, ſetting downe in the firſt ſpace of the very foot of the Table 43 degrees, as well on the right hand, as on the other, and in the ſecond ſpace 44, and in the third ſpace 45, and ſo proceed upward to 52, ſo haue you the whole latitute of France, for betwixt 42 and 52 are contained juſt ten degrées, and if your Card

be large enough, you may divide every ſuch ſpace or degrée, as well of longitude, as of latitude, into ſix parts, every ſuch part containing ten minutes.

Now to place Cities, or Caſtles, Rivers, Mountaines, or ſuch like, you muſt learne the longitude and latitude of the ſame place, either by Ptolomies Tables, or by ſome more moderne Table or Map, and then ſet them downe in your Card or Table accordingly. As for example, ſuppoſe that you would firſt ſet downe in the ſaid Table the chiefe towne of France, called Paris, whoſe longitude you find by Ioliuits Card to be 23 degrée, and ○, the latitude thereof to be 48 degrées. Here you muſt ſeeke out the ſaid longitude by extending a thread from the 23 degrée of the Parallel A B, to the like degrée in the Parallel C D, and there holding it faſt, croſſe that thread with another thread extended from the Meridian A C, to the Meridian B D, in thoſe two points, in which are ſet downe 48 degrées 10′, and whereas the two threads do croſſe, there make a little round o, and write thereon Paris, for that is his place, and as you haue ſet downe this City, ſo you may ſet downe Orleans, Roand, Lyons, Tolons, as you ſée in the former Table of France, and in like order you may ſet downe all other places and Cities whatſoeuer.

But when you would deſcribe any River, then you muſt take the longitude and latitude, as well of the beginning as of the ending thereof, and alſo the longitude and latitude of their bonts in and out, and to conſider by what towne ſuch Rivers do paſſe, and on what ſide, and whether they paſſe through the middeſt of any Towne or not, and what notable Bridges are built ouer the ſame, and by like meanes you may place in your Card, Woods, Forells, and Mountaines, and all other places whatſoeuer.

And you haue to note that all great Rivers do commonly fall either into the Sea, or elſe into ſome great lake, and the ſmall Rivers do fall into the great Rivers.

Now to make a ſcale to your Card, there is no more to do but to know the diſtance betwixt any two places, either by relation or by your owne experience, and then to draw three Parallel lines

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lines, making two ſpaces one larger and another leſſer, in ſome void ſpace of the Card of ſuch length as that void ſpace will giue you leaue, and to diuide the ſaid ſcale into ſo many miles as the length of the ſaid void ſpace will ſuffer you, and that accoꝛding to the quantity of the miles of diſtance firſt knowne. As foꝛ example, you know the diſtance betwixt Paris and Roan to be 30 French leagues, which is of our miles 60, allowing 2 miles to a French league: wherefoꝛe diuide your ſcale into 30 equall parts accoꝛdingly, and ſet downe numbers in the larger ſpace thus: 10, 20, 30, and ſo foꝛth, ſo far as your void ſpace will giue you leaue, and by taking with your Compaſſe the diſtance of any two places ſet downe in the Card, and applying the ſame to the ſcale, you ſhall know thereby how many miles ſuch diſtance containeth, and to that end the narrow ſpace would be diuided into 10 ſmall and equall parts betokening ſingle miles oꝛ leagus, as you ſee here in the ſcale ſet downe under the Table of France, and ſee that the knowne diſtance of the two places wherby you make your ſcale, may containe ſuch number of leagues oꝛ miles as do end in an article, as in 10, 20, 30.

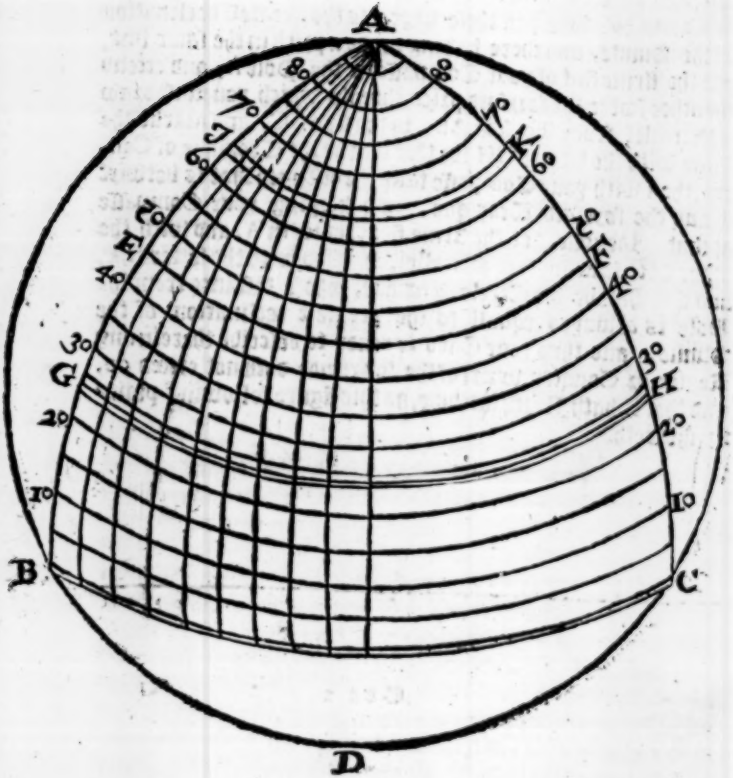
But one thing you haue to remember, that though in making theſe kinds of Cards oꝛ Tables, you be willed to dꝛaw right lines from pꝛick to pꝛick, aſwell to deſcribe the Meridians as the Parallels, yet ſuch lines would be dꝛawne with black lead, ſo as they may be all wiped out, ſaning wheras they croſſe one another in the outermoſt ſpaces wherein you haue to ſet downe the degrées and minutes, as well of longitude as of latitude: foꝛ otherwiſe thoſe right lines in ſmall Cards would ſomwhat hinder and diſgrace your woꝛke, neither ſhould it be like in all points, to thoſe of Ptolomie and of all other moderne Wꝛiters, deſcribing any Country, in like manner in thoſe Tables neither the Meridians, noꝛ the Parallels are to be ſeene, but only in the outermoſt parts as is beforе ſaid.

Here place the Map of *France*.

How to describe some particular Region or part of the earth in such sort as both the Meridians and the Parallels may be like circular lines, and may be to the eight part of convex superficies of a Globe.

FIrst draw a Circle of some large quantity, and divide the same into three equall parts, marked with the letters A, B, C, and let A be placed above, and B, C, beneath, as you see in the figure following. Then putting the firme foot of your Compasse in A, extend the other foot to B or C, and draw an arch or portion of a Circle, which may passe thorow B, C, and keeping your Compasse at that wideneſſe, set the firme foot in C, and draw the like arch from B to A, and thirdly set the firme foot in D, and draw the like arch from A to C, and suppose A to be the North Pole, and the arch B C, to be a quadrant or fourth part of the Equinoctial line, and suppose AB, and AC, to be the sides or Meridians of other two quadrants: which two quadrants, together with the third quadrant BC, do inclose the eight part of the conver superficies of the Globe, that done, divide the arch BC, into two equall parts, with the right line AD, which line AD, you must divide into 9 equall parts, or into 18 parts, containing in all 90 degrées, so shall every space containe five degrées. That done, set the firm foot of your Compasse in the point A, and draw with the other foot so many Parallels as there are points of division in the right line AD, making in all 18 Parallels, which Parallels must extend to the two outsides AB, & AC. Then divide the quarter BC, in like manner into 18 equall parts, and also divide the middle Parallel, marked with letters E F, into 18 equall parts, that done, draw thorow every division of the quadrant BC, and also thorow the division of the Parallel EF, Meridians answerable to the same, so as they may meet in the Pole A, of which Meridians, AD, is a right line, and to do that rightly you must find out a severall Center for every one of the said Meridians, which is not easily done unleſſe you have an instrument meet for the turne, and specially if the Card be of any great-

greatneſſe, and having drawne your Meridians, ſet numbers to every one of the three Quadrants, beginning to count the firſt 90 from B to C, and ſecondly from B to A, and thirdly from C to A, that done, count in the Meridian AD, from d upward 23 degrees and 30′, which in theſe dayes is the greateſt declination of the Sunne, and there having made a prick in the ſame line, put the ſtirme foot of your Compaſſe in the Pole A, and extend the other foot to the foreſaid prick, thorow which you muſt draw a Parallel from the ſide AB, to the ſide AC, and marke the ſame with the letters GH, for that ſhal be the Tropique of Cancer, then with your Compaſſe take the diſtance that is betwixt d and the foreſaid Tropique, and keeping your Compaſſe at that wideneſſe, ſet the ſtirme foot thereof in A, and with the other foot draw another Parallel, marked with the letters i, k, and that ſhall be the Circle Arctique, whoſe diſtance from the Pole is alwayes equall to the greateſt declination of the Sunne, and thus your Card is ready to deſcribe therein any Region or Country, whereof the longitude doth not exceed 90, and that it hath North latitude, as this figure following plainly ſheweth.


A
80
70
60
50
40
30
20
10
J
K
E
G
H
B
C
D

How to make a Card having circular Meridians, and circular Parallels like to thoſe of the Globe, to deſcribe therin which halfe of the world you will, ſo as it may repreſent the one halfe of the Terreſtriall Globe.

FIrſt, upon the point or Center E, which is to be ſet downe in the very middeſt of the Card which you minde to make, draw 3 Circles, one within another, making two ſpaces in ſuch ſort as the outermoſt ſpace may have ſome breadth to containe therein the number of degrées to be written in Arithmetical figures, and let the innermoſt ſpace be a very narrow ſpace fit to containe the degrées as you ſee in this preſent figure, that done, divide the innermoſt Circle into 4 quarters, with two Diameters croſſing one another with right angles in the Center E, and marke the Perpendicular Diameter with the letters A C, whereof A ſignifieth the North Pole, and C the South Pole, and marke the overthwart Diameter, ſignifying the Equinoctiall with the letters B D, whereof B is the Weſt point, and D the Eaſt point, then divide every quarter into 90 degrées, beginning to account from B to A, and alſo from D to A upward, and from B to C, and likewiſe from D to C, downward, then apply your Ruler to the Pole A, and to the fift degrée of the innermoſt Circle proceeding from B to C, and whereas your Ruler croſſeth the Equinoctiall, there make a pricke upon the Equinoctiall, and ſo proceed towards C, from 5 degrées to 5 degrées, and againe from C to D, in like manner not forgetting to ſet downe prickes upon the Equinoctiall at every ſection, ſo ſhall you divide the Equinoctiall into 180 degrées, counting from B to D, and therefore you muſt ſet downe upon the Equinoctiall the numbers of the degrées, thus: 10, 20, 30, and ſo forth untill you come to 180, as you ſee in the former figure. Then by laying the one end of your Ruler to B, and the other end to every fift degrée of the Semi-circle A, D, C, divide the Meridian A, C, as you did before divide the Equinoctiall B, D,

making pricks or strokes upon every section or division of the same Meridian A,C, and these two lines (that is to say) the Equinoctiall line, and the Meridian line being thus divided, you must draw upon the two Poles A,C, Geographicall Parallels, whereof you may draw two by setting the one foot of your Compasse in the Pole A, and the other foot in the first section of the Meridian A,C, that is next unto A, and keeping your Compasse at that widenesse, you may make the like Parallel upon the South Pole by setting the one foot in the point C, and the other in that section of the said Meridian that is next unto C, but to finde out the Centers of all the rest of the Parallels, both Northward and Southward, you must draw out the line A,C, at both ends so long as you can, for in that line you have to finde out all the Centers, which Centers must be such as the firme foot being set therein, the other foot may passe thorow every section of the Meridian line, and also thorow every fift degree of the inward Circle containing the degrees on both sides of the said Meridian, and having drawne after this manner the 18 Northerne Parallels you may easily draw the other 18 Southerne Parallels, by marking well the first Centers of the Northern Parallels, taking the just distance of every one with your Compasses, and by setting downe the same upon the Meridian line A,C, on the South part thereof.

Now to describe the Meridians, you must draw out the line B,D, at both ends so far in length as shall suffice, in which line you have to find out the Center of every Meridian, first of those in the West part, and then of those in the East part, by setting the one foot of your Compasse in the Center, and the other foot so as it may passe thorow every section of the line B,D, and also thorow both the Poles, and having drawne the Westernly 18 Meridians, you shall easily draw the Easternly Meridians, by reducing the selfe same distances of Centers unto the West part, by helpe whereof you did draw the Easternly Meridians, or else you may draw first a West Meridian, and then an East Meridian; whilest the Compasse is at one selfe widenesse, and thereby you shall draw two Meridians at one instant, and you may also observe the like order in drawing the North and

South.

South Parallels before mentioned. Then you have to draw the two Tropiques, and the two Polar Circles in manner and forme following: firſt to draw the Tropique of Cancer, ſet one foot of your Compaſſe in the Center E, and the other foot in the Meridian or line A, E, at ſuch diſtance as is the greateſt declination of the Sun, which is 23 degrées, and 30', and there ſet downe a prick or mark, then as well from D towards A, as from B to A, count the ſaid greateſt declination of the Sun, which is 23 degrées, 30', and there make a marke on the innermoſt of the three outward Circles on both hands, that done, take a Center upon the extended line A, F, ſo as from thence you may draw a Circle that may paſſe thorow the three markes laſt mentioned, and that ſhall be the Tropique of Cancer, then keeping your Compaſſe ſtill at that wideneſſe, tranſferre the ſame to the extended line C, G, ſetting the firme foot, ſo as you may draw with the other foot another Circle that is of like diſtance from the Equinoctiall, and that ſhall be the Tropique of Capricorne.

Now to draw the Polar Circles, you muſt do thus: Number upon the firſt Meridian A, C, from the Pole towards E, the greateſt declination of the Sun, and there make a mark, and again, from the Pole upon the innermoſt Circle on both ſides of the Meridian, count the like quantity of degrées, and marke the ſame quantity upon the firſt Meridian, then having found the Center in any of the extended lines belonging to the Poles, draw a Circle thorow thoſe three markes, and the Circle drawn towards A, ſhall be the Circle Arctique, and the other drawn towards C, with like wideneſſe of your Compaſſe, ſhal be the Circle Antarctique, and ſo your Card is ready to deſcribe therein what places you will, knowing the longitude and latitude thereof, and that the longitude do not exceed above 180 degrées. And I take this forme of Card to be the beſt both for Sea and Land: for every Region therein deſcribed muſt needs have his true ſhape, ſo as you know the true longitude and latitude of the outtermoſt bounds and limits thereof.

Beſides theſe manner of Maps Plancius ſetteth downe the whole earth in two ſeveral rundles, each one containing the juſt halfe of the earth, that is to ſay, the North halfe, and the South

halfe, making the Equinoctiall in each halfe the vttermoſt Circle, and the Center of the North rundle ſignifyeth the North Pole, and the Center of the South rundle ſignifyeth the South Pole, which manner of Mapp, becauſe I haue already plainly ſet downe together with the vſe thereof in my deſcription of Plancius his vniverſall Mapp, I leaue to deale any further therwith. I haue ſeene alſo many yeares ſince an vniverſall Mappe made by a French man, which was round in ſhape like vnto a planiſphere hauing both the Poles placed in the very Center thereof, which Mapp becauſe I cannot get here in England for any money, I am forced to leaue vndeſcribed, and inſtead thereof I thinke good to ſet downe here the deſcription of a very good Mapp of Europe made by Mercator in the yeere of our Lord 1554, becauſe the manner of making the ſaid Mapp doth greatly pleaſe me.

Maſter Blundevill *his Deſcription of an excellent good Mapp of Europe, made by* Mercator *in the yeere of our Lord* 1554, *in which Deſcription is firſt ſhewed the manner of making the ſaid Mappe, and then the vſe thereof.*

FIrſt, the ſaid Mercator conſidered what longitude and latitude Europe hath, and knowing partly by the ancient Tables of Ptolomy, and ſuch others, but chiefly and moſt truly by the moderne Mapps and Sea Cards, that Europe had in longitude no more than 70 degrees, counting from the firſt Meridian paſſing thorow the Iles Canary otherwiſe called Inſulæ Fortunatæ, vnto the Meridian which paſſeth thorow the ſtood Tanais, which is the vttermoſt bound or limit of Europe, towards the Eaſt, diuiding the ſame from Aſia, yet becauſe he thought good to ſet downe in his Mapp a good part of Aſia, whereon Europe abutteth or boardereth towards the Eaſt, he made the ſaid longitude in his Mapp to extend Eaſtward 100 deg. euen to the further ſide of the great ſtood Oby; and though he found by the aforeſaid

Tables

Tables and Sea Cards, that the latitude of Europe was no more but 40 degrées, counting from the Parallel of 30 degrées of North latitude, vnto the Parallel of 70 degrées of North latitude, yet he maketh his Map to extend farther, as well Northward as Southward, as you may plainly ſee in beholding the ſaid Card. Theſe things being preſuppoſed in the way of preamble, I will now ſhew you what order he obſerued in making the ſaid Card. Firſt, he drew a right perpendicular line thorow the midſt of his Card, which he calleth the middle Meridian, ſignifying the axle-tree of the world, which line he extended right out a good way Northward beyond his Map, about the quantity of the third part thereof, to the intent that the North end of that line, ſignifying the North Pole, might be the Center whereon he had to draw all his Parallels, contained betwixt the 30 degrées and 70 degrées of North latitude: and for that purpoſe he diuided with his Compaſſe the middle Meridian, being ſo extended from the 30 Parallel to the very Pole, into 12 equall parts or ſpaces, and every ſuch ſpace into 5 degrées, which maketh in all 60 degrées, counting thoſe degrées from the nether end of the middle Meridian crolling the 30 Parallel vnto the foreſaid Center, vpon which Center, ſetting the firme foot of his Compaſſe, and extending the other to the lower end of the ſaid middle Meridian, whereas it crolleth the 30 Parallel, he draweth his firſt Parallel ſo far on both hands as his Card will ſuffer him, which Parallel according to the quantity of the ſpace of the degrées, he draweth thorow the pricks of diuiſion, ſet downe in the middle Meridian, the reſt of the Parallels vntill he come to the 70 degrée of North latitude, that done, he diuideth as well the vpper Parallel as the nether Parallel, each of them into twenty equall parts or ſpaces, every ſpace containing five degrées, thorow which diuiſions hee draweth his Circular Meridians, or rather portions of Circular Meridians, ſome greater, ſome leſſer, by finding out fit Centers to draw thereon the ſaid portions of Circles on both ſides of the middle Meridian thorow theſe ſeuerall pricks or points, whereof one muſt bee alwayes that which ſignifieth the North Pole, which is cleane without the Card, and the other two

pricks

pricks are to be sought in the two Parallels that are divided, as before each of them into 30 parts, which two pricks must answer one another, according to the like number of degrées of the said two Parallels, as 10 to 10, 20 to 20, and so forth. As for example, suppose that you would draw a Meridian that may passe thorow the 20 section of the 30 Parallel, and also thorow the 20 section of the 70 Parallel, and thirdly thorow the Pole: here to finde out an apt Center to draw this Meridian, it is not easie, unlesse you have an Instrument méet for the purpose, like to that which Master Blagrave setteth downe in the fourth Book of his Mathematicall Jewell, Chap. 20, made according to the doctrine of Euclide: for to finde out all the Centers of the said Meridians in this little Card, according to Euclide his Rule of drawing a Circle thorow three pricks, would require an even floore, almost 40 foot square.

Thus having drawne the Parallels and Meridians of his Card, he setteth downe therein all such notable places as are contained in Europe, as Townes, Rivers, Seas, Ilands, mountaines, and such like, as well according to their true longitudes, and latitudes, as also according to their true direction, that is to say, how one place beareth from another, as East, West, North or South, and so forth: wherein he was greatly holpen by the Sea Cards lately made by skilfull Pilots. And it séemeth by the Card whereby I made this description, that Mercator had an intention to set downe in the said Card certaine Flies of direction, to shew thereby how every place doth beare each one from another, which Flies though they do not all plainly appeare, yet the print of some of them is still to be séene in the said Card. I thinke that Mercator caused them to be cancelled for feare of occupying too much rowme in his Card, and thereby to hinder the view of many places, néedfull to be set downe in the said Card.

Moreover, he addeth to his said Card three severall Scales, one of latitude, the second of longitude, and the third of distance: By the first you may easily finde out the true latitude of any place, and by the second the true longitude of any place contayned in the said Card, and by the third Scale you may know how

many

many miles, according to the diverſity of miles in every ſeverall Region one place is diſtant from another, the deſcription and uſe of all which three Scales hereafter followeth.

The deſcription and uſe of the Scale of latitude.

THe Scale of latitude conſiſteth of 4 right lines, making three colums, every one cõtaining in length one ſuch whole ſpace as is contained betwixt any 2 Parallels ſet down in the Map, and as every ſuch ſpace is divided into 5 degrées, ſo likewiſe is the length of the Scale as you may ſée by the number ſet downe in the firſt colum on the left hand thus: 1, 2, 3, 4, 5, and every degrée is divided into ſix equall parts, as you may perceiue by the ſecond colum, and every ſuch part is divided into 10, as you may perceiue by the third colum, ſo as every whole degrée is divided into 60, the uſe of which Scale is to finde out the true latitude of any place contained in the Map, thus.

Set the one foot of your Compaſſe in the place whoſe latitude you ſéek, extending the other foot to the Parallel which is next unto that place, which Parallel if it be beneath the place, then apply that wideneſſe of your Compaſſe unto the lower part of the Scale, by ſetting the one foot thereof at the loweſt end of the Scale, & the other foot upward ſo far as the wideneſs will extend them, looke how many deg. and minutes are contained betwixt the 2 feet of your Compaſſe, & adde that unto the number of the aforeſaid Parallel ſet down in the Map, and the ſum thereof ſhalbe the latitude of the place. But if you do extend your Compaſſe from the place whoſe latitude you ſéek, to the next Parallel above it: then you muſt apply that wideneſſe of your Compaſſe to the upper part of the Scale, ſetting one foot of your Compaſſe in the very top thereof, & the other downward ſo far as that wideneſſe will reach, then look how many degrées and minutes are contained betwixt the two feet of your Compaſſe, and ſubtract that from the number of the ſaid upper Parallel ſet down in the Map, & the remainder ſhall be the latitude of that place.

As for example, you would know the latitude of Rome, which

is:

is the chiefest City in Italy. Here having found out Rome in the Map, you must first set one foot of the Compasse in that very place, extending the other foot unto the next inferiour Parallel, that done, keeping your Compasse at that wideneſſe, apply the same unto the Scale, by setting one foot at the lowest end of the Scale, and the other upward so farre as that wideneſſe will reach, then looke how many degrees and minutes are contayned betwixt the two feet of your Compasse, and you shall finde it to be one degree, 48 minutes, which being added to the number of the foresaid next inferiour Parallel, which is 40, set downe in the Map, it will make in all 41 degrees 48' and that is the latitude of Rome. But if you do extend your Compasse from Rome to the next upper Parallel, then in applying the wideneſſe to the Scale, you must set one foot of your Compasse in the very top of the Scale, and the other downward, so far as that wideneſſe will extend, and by looking how many degrees and minutes are contained betwixt the two feet of your Compasse, you shall find them to be 3 degrees, 12', which being taken from 45, which is the number of the next upper Parallel, there will remaine 41 degrees 48', as before.

Then having the latitude of Rome, you may easily finde out the longitude therof by helpe of the Scale of longitude, set down in the Map, the description and use whereof hereafter followeth.

The description and use of the Scale of longitude.

THis Scale, as you see, consisteth of 30 long right lines signifying Meridians, drawne from the left hand toward the right, whose spaces do war straighter and straighter towards the Pole, which Meridians are crossed with 40 circular Parallels, proceeding orderly from the 30 Parallel to the 70. every one shorter than other towards the Pole, as you may perceive by the number set downe, as well above as beneath the Scale, and as the first and greatest Parallel on the left hand is divided into five degrees, and every degree into six parts,

so

ſo is every other Parallel, be it never ſo ſhort, the uſe of which Scale is thus: Firſt, having found the latitude of any place by helpe of the Scale of latitude before deſcribed, you muſt keepe your Compaſſe ſtill at the wideneſſe of the latitude firſt found, and apply that ſame wideneſſe unto that Meridian, which is nereſt unto the place, by ſetting one foot in the former Parallel whereas the next Meridian doth croſſe the ſame, extending the other foot upon the ſaid Meridian upward, ſo farre as that wideneſſe will ſuffer, and there make a prick, in which prick ſet the one foot of your Compaſſe, and extend the other to the place, and apply that laſt wideneſſe to the Scale of longitude, by ſetting the one foot in the nether ſide of the Scale, at the very latitude before found, and extend the other upon the ſame Parallel of latitude, ſo far upward as that wideneſſe will ſuffer: then look how many degrées and minutes are comprehended betwixt the two feet of your compaſſe, and adde that to the number of the foreſaid next Meridian, ſet down in the Map, and if the ſame Meridian be on the left hand of the place, then it is welterly from the place, but if the next Meridian, which you take, be on the right hand, ſtanding on the Eaſt ſide of the place, then you muſt ſubtract the degrées and minutes found in the Scale of longitude from the number of that Meridian, ſet down in the Map, and the remainder ſhall be the longitude of the place. As for example, having found the longitude of Rome by helpe of the Scale of latitude, to be 41 degrées 48′ as is aforeſaid, here keeping your Compaſſe ſtill at the former wideneſſe, apply the ſame to the next Meridian on the left hand, by ſetting one foot in that point, whereas the ſaid Meridian croſſeth the Parallel of latitude, and the other foot ſtill upon the ſame Meridian upward, ſo far as that wideneſſe will extend, and there make a prick, in which prick having ſet the one foot of your Compaſſe, extend the other foot to the place where Rome ſtandeth, that done, apply that laſt wideneſſe of your Compaſſe unto the nether part of the Scale of longitude, by ſetting the one foot in the very degrée & minute of the former found latitude, and the other foot upon the ſame degrée and minute of latitude. Then look how many degrées and minutes are comprehended betwixt the two feet of your Com-

paſſe,

paſſe, which you ſhall finde to be 1 degrée, 10′, and by adding that to the number of the nert Meridian on the left hand, ſet down in the Map, which is 35 degrées, it maketh in al 36 degrées 10′, and that is the longitude of Rome. But if you make choyce of the nert Meridian on the right hand, whoſe number is 40 degrées, then you muſt ſubtract the degrées and minutes contained betwixt the two feet of the Compaſſe, which you ſhall finde to be 3 degrées, 50′, out of the nert Parallel on the left hand, which is 40 degrées, and there will remaine 36 degrées, 10′, as before.

The Scale of diſtance.

THis Scale needeth no deſcription, becauſe it is plainly ſet downe in the Map, ſhewing the diverſity of leagues or miles, belonging to every Nation or Region, wherefore if you would know the diſtance betwixt any two places ſet downe in the Map, you have no more to do, but to take with your Compaſſe the juſt diſtance betwixt theſe two places, & to apply that widenelle to the Scale, by ſetting the one foot of your Compaſſe in the beginning of thoſe miles, that are anſwerable to the Region, or rather to thoſe kind of miles which you ſeeke to know, and extend the other foot upon that part of the Scale, ſo far as that widenelle will ſuffer you, and the number of miles comprehended betwixt the two feet of your Compaſſe, will ſhew you the true diſtance betwixt the two places. By this meanes you ſhal finde the diſtance betwixt Rome and Naples, to be 120 miles: but if the diſtance of the two places, ſet downe in the Map, be longer than the Scale it ſelfe, then you muſt firſt take the whole length of that part of the Scale which is anſwerable to thoſe miles which you ſeeke, and by keeping your Compaſſe at that widenelle to meaſure by a right line how many times the ſaid widenelle is comprehended betwixt the two foreſaid places, and the number of miles ſhall be the diſtance: but if there be any odde meaſure, then you muſt ſtraighten your Compaſſe to anſwer that odde meaſure, and apply that widenelle to the beginning of the aforeſaid Scale, and adde that to the former number,

THIS CHART W

FIFTH CHART A

AT THE END O

ART WILL BE THE
HART APPEARING
END OF THIS FILM

ber, whoſe totall numbers ſhall be the diſtance betwixt the two places.

Moreover, you ſhall finde on the right ſide of this Map the peregrination of the Apoſtle S. Peter, and right under that, the peregrination of S. Paul, ſhewing in how many places they preached the word of God, what miracles they did, and where. And in the foot of the Map on the right hand is ſet downe the peregrination of Jeſus Chriſt, ſhewing the places where he preached or did any great miracles.

Finally, about the middeſt of the Map you ſhall finde certaine Characters, ſhewing which Townes are the ſeats of Biſhops, Archbiſhops, Patriarks, Popes, and ſuch like.

And thus I end, praying you to take my labour herein beſtowed, well in worth, which I would not have done, but that I know this Card to be a neceſſary Card, and to be made with very good Art, according to the Example of which Card, the ſonne of old Mercator hath lately cut forth divers ſmall Cards of Europe, traced with lines and Circles, like to theſe of his Fathers Card, the uſe of which lines and Circles, I feare me, that few do rightly underſtand, and for that cauſe I was the more willing here to ſet downe this plaine deſcription of the Fathers Card.

FINIS.

ARTS AND SCIENCES MATHEMATICALL

TAught in Fetter-lane neare the golden Lyon, or privatly abroad at convenient houres, by *Robert Hartwell* Teacher of the *Mathematicks*.

Viz.

- Arithmetick,
- Geometry,
- Astronomy,
  - Cosmography,
  - Geography,
  - Navigation,
  - Architecture,
  - Fortification,
  - Horologiography, &c.

Measuring of Land.

The doctrine of Triangles { plaine and spherical. } the use of the Tables of { Sines, Tangents, Secants, & Logarithmes. }

Accompts for *Merchants* by order of Debitor and Creditor.

Vide — *Sed* — *Vide.*

Vivat Rex.

The Sexagenarie Table whereby the Products in Multiplication, the Quotients in Division, and the ſquare Rootes are found in Aſtronomicall Fractions.

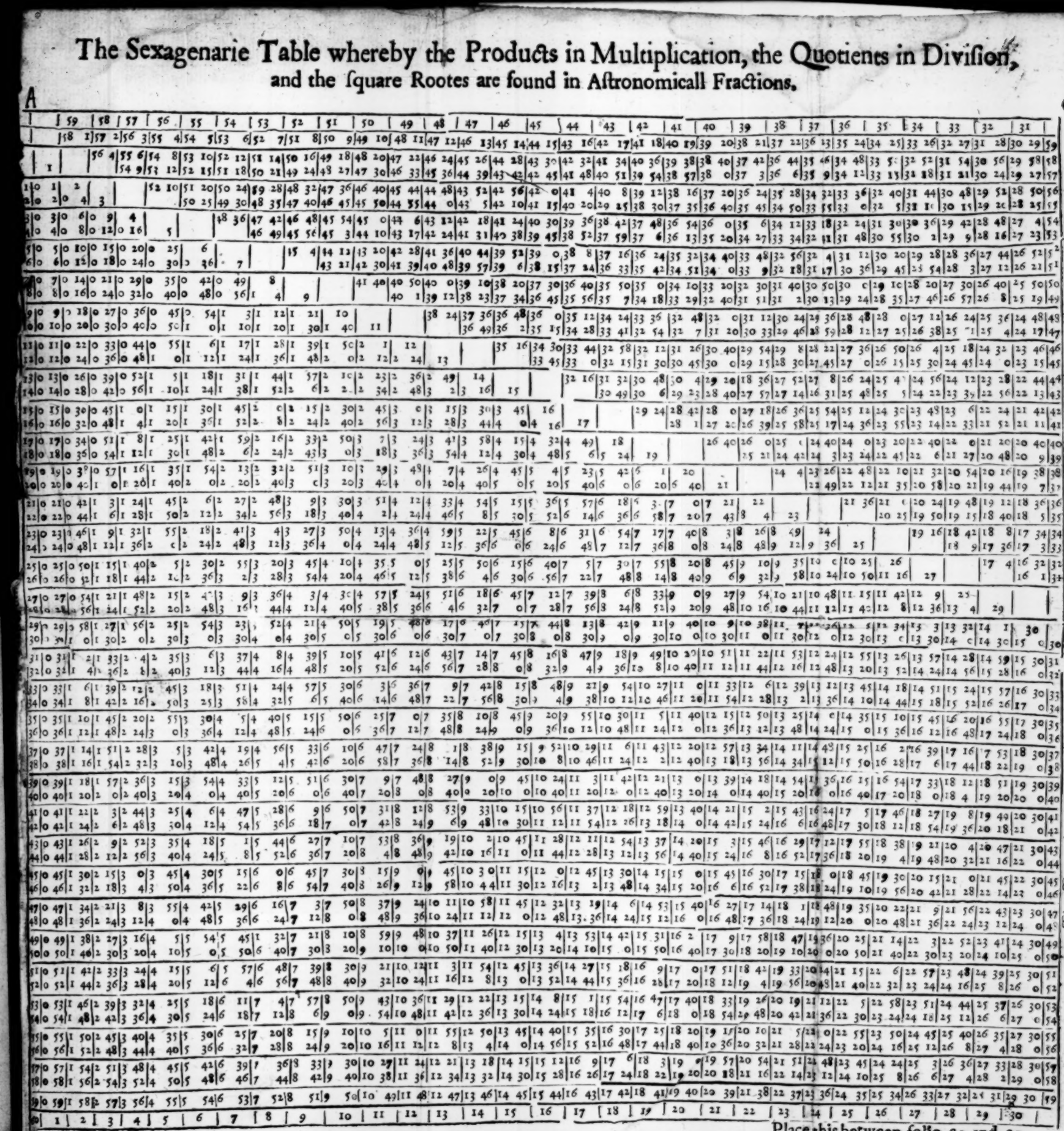
A

C

The I Page.

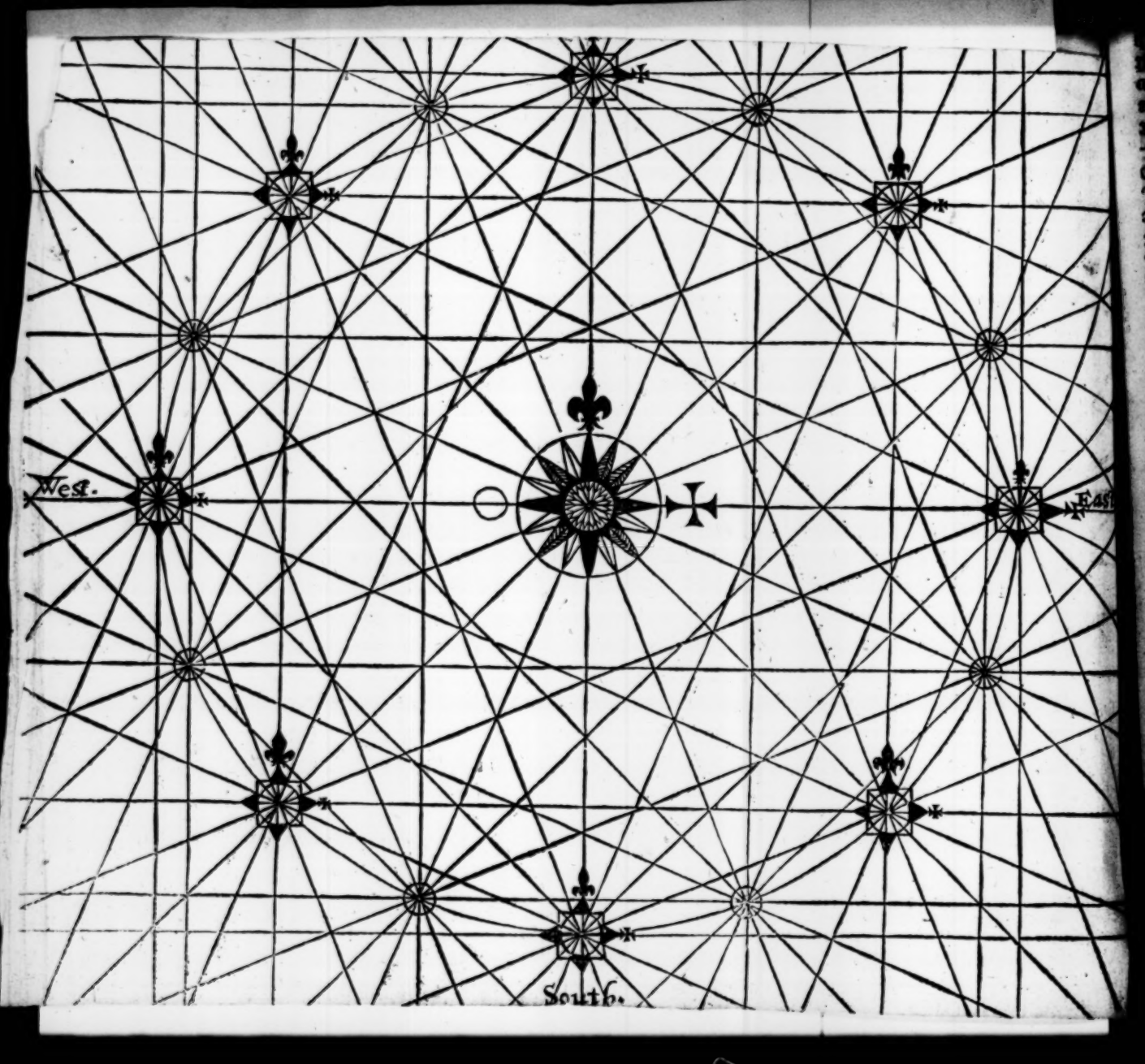
The I Trapezium.

B

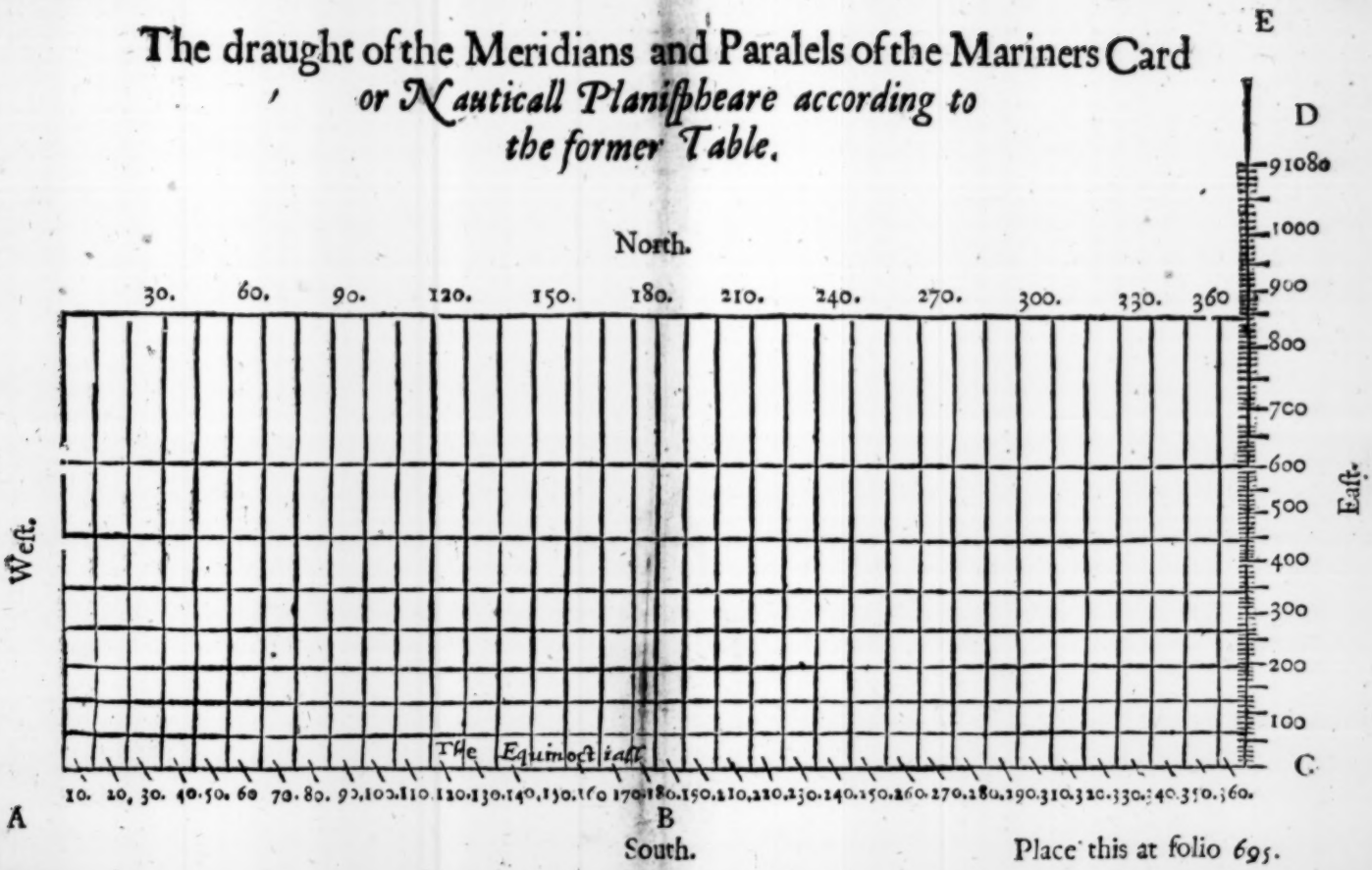


Place this between folio 80 and 81

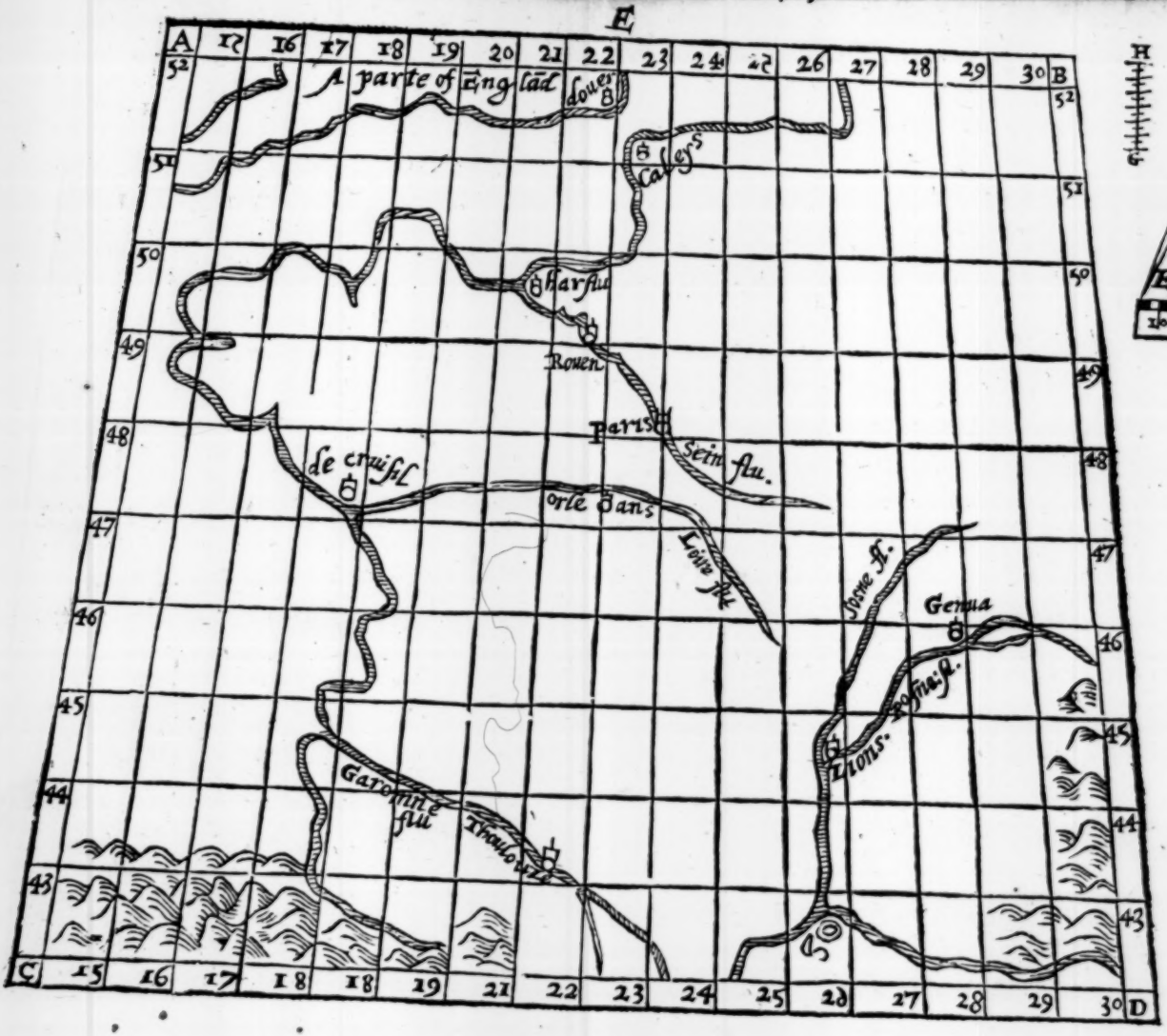
E

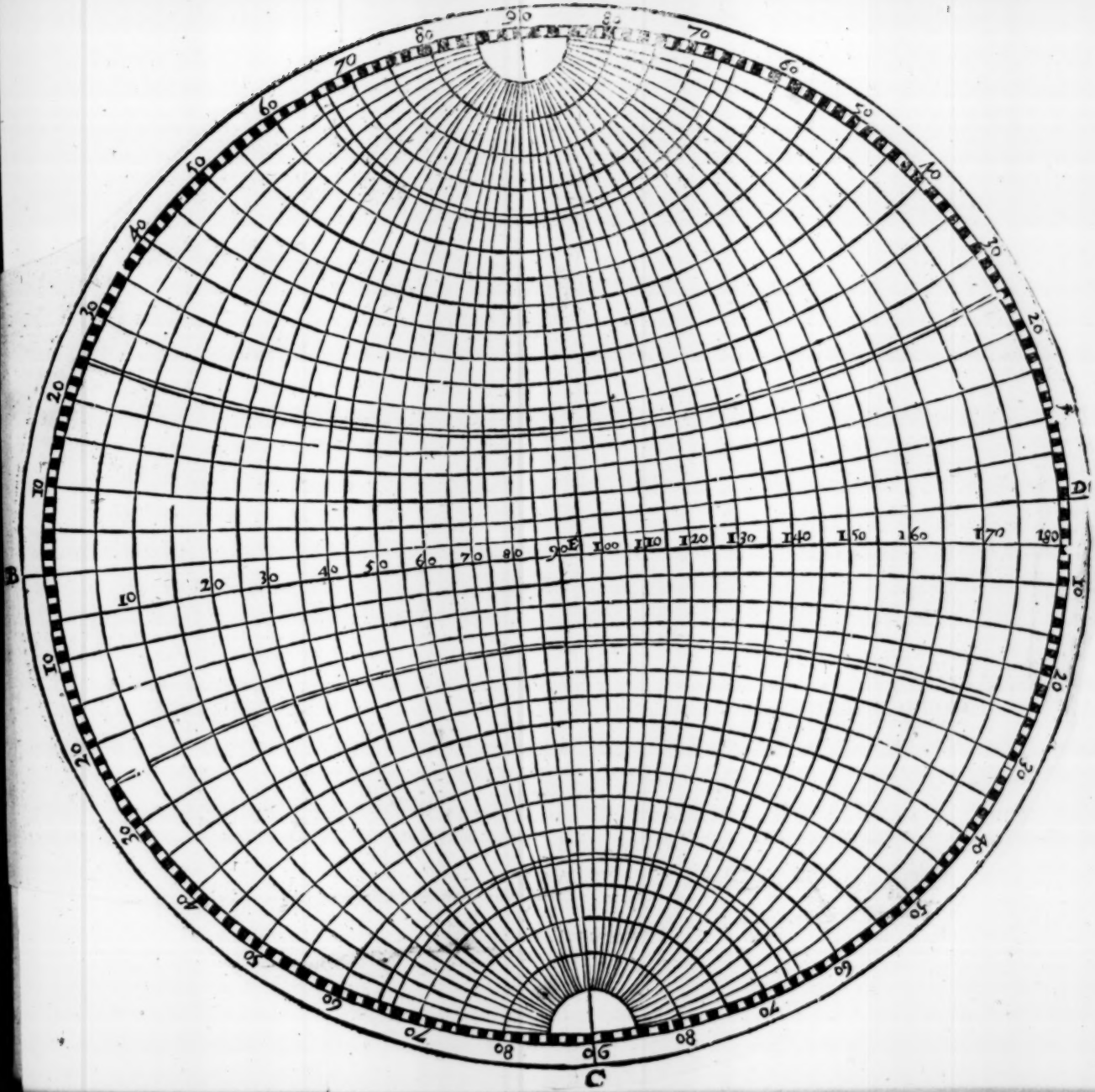

West.
East.
South.

The draught of the Meridians and Paralels of the Mariners Card or *Nauticall Planisphere according to the former Table.*



Place this at folio 695.


E
A
B
C
D
H
G
A parte of Englad
douer
Calays
harfleu
Rouen
Paris
Seine flu.
de cruiſſ
orle ans
Loire flu
Iosne fl.
Genua
Garomne flu
Thoulouſe
Lions
Rosne fl.
The Scale for Englishe mile


B
C
D
E
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180